Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

Vol. XXI.] JULY 1933 [No. 7.

CONTENTS

ORIGINAL ARTICLES :—

	Page
1. The Case for the Electro-Chemical Fixation of Atmospheric Nitrogen in India	291
2. Studies in Poultry-Keeping	299
3. Flue Curing and Grading of Tobacco in the Guntur District	305

SELECTED ARTICLE

	Page
The Value of Scientific Research to Agriculture	312
Notes and Comments	315
Abstracts	317
Gleanings	320
Review	323
Crop and Trade Reports	325
College News and Notes	327
Weather Review	329
Departmental Notifications	330
Additions to the Library	331

THE CASE FOR THE ELECTRO-CHEMICAL FIXATION OF ATMOSPHERIC NITROGEN IN INDIA*

By B. VISWANATH, F. I. C.,

Government Agricultural Chemist, Coimbatore.

The most outstanding recent achievement of science, directly and intimately connected with food production, is the electro-chemical fixation of atmospheric nitrogen. With the aid of electricity it has been possibile to "fix" atmospheric nitrogen and produce several products for fertilising the soil, such as ammonium sulphate, ammonium phosphate, calcium cyanamide and urea. J. G. Lipman, Director of the New Jersey Agricultural Experiment Station gives in a recent number of the 'Journal of the American Society of Agronomy (March 1932)' figures for the world's electro-chemical fixation of nitrogen, as shown in the statement below:—

Statement No. I giving the world's electro-chemical fixation of nitrogen in tons per year from the year 1909 to 1930.

Year.	Nitrogen Tons.
1909	569,250
1913	899,800
1917	1,205,000
1924—1925	1,154.000
1928—1929	2,113,000
1929—1930	2,178,400

* Lecture delivered at a joint session of the Indian Chemical Society (Madras branch), the Society of Biological Chemists (India) and the Association of Economic Biologists (Coimbatore) on the 8th October 1932 under the Chairmanship of Major Howard, Chief Engineer, Hydro-electric Development. Madras.

The processes at present in use for fixing atmospheric nitrogen using electricity are

i) the 'Haber Bosch process' in which nitrogen and hydrogen combine to form ammonia

ii) the 'arc process' in which nitrogen and oxygen combine to form nitric oxide

iii) the 'cyanamide process' in which nitrogen and calcium carbide combine to form calcium cyanamide

iv) the 'catalytic process' in which ammonia obtained by methods (i) and (iii) is converted into nitric acid and nitrates by catalytic oxidation.

Several countries in the world have built plants for the fixation of nitrogen utilising one or more of the above methods as will be be seen from the statement.

Statement No. II giving the countries of production and the total capacity of the plant in tons of nitrogen per year.

Country.	Area (sq. miles).	(Lipman) Nitrogen Tons.
India including Aden	1,766,600	Nil
Belgium	11,370	106,500
Canada	3,620,000	82,500
Czechoslovakia	...	18,500
England	58,324	175.000
France	207,200	168,300
Germany	203,720	938,500
Italy	110.600	79,900
Japan	162,655	118,600
Netherlands	12,560	77,000
Norway	124,090	100,000
Poland	...	75.000
Russia (in Europe)	2,052,490	7,000
Rumania	50,700	5,000
Spain	194,740	8,500
Sweden	172,880	8,000
Switzerland	15,470	12,000
United States of America.	3,025,600	195,600
Yagoslovakia	...	28,000
Total		2,203,900

It will be noted that India is producing nothing. Why? Does she not possess the necessary materials and facilities? Let us examine. Nitrogen is available in plenty in India as in any other country. Every square yard of land has about seven tons of free nitrogen lying over it. There is abundance of coal and lime. As for electricity, we have the authority of J. W. Mears, Chief Engineer, Hydro-electric Survey, who in his triennial report for 1919—21, estimated the probable water power of India for "maximum development" as 12,680,000 kilowatts equal to two and a half million water horse power of which only 1¼ % was then either developed or was in course of development. We have now nearer home, the Pykara power. We seem to have all

the facilities and yet we are not doing the first essential thing necessary for the development of agriculture and increased food production.

The problem of nitrogen fixation in India has been under discussion within the past ten years. The Indian Sugar Committee was the first to study the subject and to express the opinion that the successful introduction of synthetic process for nitrogenous fertilisers was a matter of first importance. The possibilities for the manufacture of nitrogen fixation products in India were considered by the Board of Agriculture in India, at its meeting held in Pusa in February 1922. In the opinion of the committee appointed by the Board, the field for the use of nitrogen fixation products was limited, as the cost per unit of nitrogen was too high for the ordinary ryot to manure the staple food crops, and so the prospects were not encouraging. The committee, however, were of the opinion that they could support Government efforts in the direction, in connection with ordinance factories for nitrogen products. Such factories must necessarily produce in excess of military requirements in times of peace and this excess could be used to give some indication of the limiting unit price which would make this fertiliser attractive to the Indian cultivator. The Indian Science Congress at its joint meetings in 1923 discussed nitrogen problem of India in general. In the course of the discussion Lieutenant Colonel Battye, Superintending Engineer, Hydro-electric Circle, the Punjab, examined the hydro-electric aspect of the subject. His opinion was that in Southern India where most hydro-electric developments depend on seasonal storage it might not be possible to bring down the cost of power within electro-chemical limits except in the case of large projects. In Northern India, on the other hand, river flow projects were possible and power should be available at 16 hours a day throughout the year at practically no cost to the producer. Judging from the figures supplied by the American Ordinance Office report on the fixation and utilisation of nitrogen, he estimated that, if power was available at one pie a unit, it should be possible to produce ammonia at three annas a pound as against the present price of Rs. 0–5–4 a lb. for the imported stuff. The Royal Commission on Agriculture in India examined the position afresh in 1926 and 1927 and considered that at least in the near future, the prospects for the manufacture of nitrogen products were not encouraging. I quote their views in extenso. After briefly examining the recommendations of the Indian Sugar Committee who were in favour of manufacturing nitrogen fixation products in India, the Royal Commission on Agriculture say:

"The position has changed greatly since the report of the Sugar Committee was written. The full effects of the diversion of the capital, enterprise and, above all, the research devoted to the manufacture of munitions to the production of peace-time requirements had not been felt in 1920. Since then, it has resulted in a fall in the world's price of nitrogen by fifty per cent and there are prospects of still lower prices in the near future. We see no reason to question the view

which was placed before us in the course of the evidence we took in London that, in present circumstances, only very large units with a minimum capacity of about 150,000 tons of pure nitrogen per annum can be expected to pay even under the most favourable conditions in Great Britain and on the Continent of Europe and that conditions in India make it much less likely that even a unit of that capacity would prove a paying proposition. The possibilities of manufacturing nitrogen from the air in India have already been exhaustively examined by a leading firm of chemical manufacturers in England which has decided against proceeding with the project. It is probable that no factory on a scale which could be contemplated by any local government, or even by the Imperial Government, would be in a position to produce synthetic nitrogenous fertilisers at a price less than that at which they can be imported. The whole object of establishing such a factory, that of producing fertilisers at a price which would place them within the reach of a far greater proportion of the agricultural community than is at present in a position to use them. would be defeated if a protective duty were imposed to enable its out-turn compete against imported supplies. It is also to be hoped that should the demand for artificial fertilisers in India make it worth while, private enterprise will come forward to erect synthetic nitrogen works in this country While the economics of the industry remain as they stand to-day, we are unable to recommend any further investigation into the subject under government auspices"

It will be noted that, in effect, the Royal Commission relegate the possibilities to a distant date. Are we to rest content here? We see that already many countries have erected plants of their own and are producing nitrogen fixation products. Is there already over production in the world? If so, there is perhaps no justification for India to produce still more. If the production is still below demand, there is every justification for India to make serious urgent efforts at least at experimental researches on the ways and means of producing different nitrogenous fertilisers under our conditions. If there is a case, the sooner we bestir ourselves the better. Already we have the handicap of being late in the field. Further delay only makes the handicap heavier. I am second to none in the view that no greater disservice can be done to Indian agriculture than to encourage the use of commercial fertilisers to the detriment of the conservation of every other source of other forms of nitrogen readily available at the disposal of the ryot. But if an examination of the world's food position generally and that of India in particular, shows that, for feeding the population, the available natural supplies are inadequate and that the artificial utilisation of atmospheric nitrogen is necessary, the position cannot be easily ignored. Let us, therefore, examine the nitrogen position in relation to food.

Lipman (*Journal of American Society of Agronomy*, March 1932) gives the world's population between 1900 and 1930 and the amount of nitrogen consumed as food in the following statement:—

Statement No. III showing the world's population and the consumption of nitrogen as food as calculated by Lipman from 1900—1930.

Year	World's Population.	Consumption of nitrogen as food as calculated by Lipman at 100 grams protein per head.
		Tons.
1900	1,500,000,000	4,390,000
1910	1,523,000,000	4,460,000
1920	1,700,000,000	4,970,000
1930	2,000,000,000	5,850,000

Thus, the present requirement of the World's population in terms of food nitrogen is six million tons. The present world's capacity for nitrogen fixation is two million tons per annum. The production of Chili salt-peter has remained stationary at two million tons a year, which is equivalent to one-third million tons of nitrogen a year. Thus we have at present two and one-third million tons of fixed nitrogen as against a requirement of six million tons for feeding the population of the world. It must be stressed here that six million tons represent nitrogen actually taken in as food. Assuming that the food eaten is vegetarian and a nitrogen efficiency of twenty per cent. in the grain as worked out for England by Slade (c. f. Chemistry and Industry, Sep. 12, 1930), it would require thirty million tons of nitrogen to be added as manures or fertilisers. For meat diet the figures are still higher. Fortunately, Nature has provided various other sources of nitrogen, so that we need not have to find this tremendously large amount of nitrogen by way of artificial fixation.

The position in India may now be examined. Lipman has taken 100 grams. of protein as the average daily requirement of an American. This is equivalent to sixteen grams of nitrogen per day. A. W. Flux, in his presidential address to the Royal Satistical Society (June 1930) on "Our food supply before and after War" fixed 86·5 grams of protein consumption per head per day in England. This is equivalent to 14 grams of nitrogen per head per day. For India, I have assumed that the food requirements are lower than for either America or England and have taken 75 grams of protein consumption or 12 grams of nitrogen per head per day. On this basis, the amount of nitrogen necessary for feeding a population of 353 millions is calculated and given in the Statement No. IV below.

Statement No. IV giving the individual and total requirement of nitrogen for consumption as food, by the population of India including the Indian States.

Poaulation.	Consumption of nitrogen per head per day.	Consumption of nitrogen per head per year	Total requirement of nitrogen by the entire population in a year.
	grams	lbs.	tons
353,000,000	12	9·66	1,522,312

Statement No. V giving the total area under, and the out-turn of, the principal food grains for the whole of India including the Indian States, together with the amounts of nitrogen removed by these. Season 1929—1930.

Grain.	Area. (rounded to thousands acres.)	Out-turn basis. (husked) per acre. lbs.	Nitrogen in grain. %	Total amount of nitrogen for the whole area. Tons.
Rice	80,479,000	900	1·2	3,88,017
Wheat	31,654,000	750	2·5	2,64,961
Barley	8,787,000	750	2·5	71,185
Millets	63,335,000	450	1·5	1,90,853
Maize	8,724,000	560	1·5	31,822
Grains	17,039,000	300	4·0	91,280
Other grains	36,982.000	200	1·0	33,020
Total.	247,000,000			1,071,138

Note:—The average amount of nitrogen removed in a year, by the above food grains is 9·71 lbs. per acre.

The statement shows the amount of nitrogen actually obtained as food grains in the season 1929—30. Thus, in so far as food is concerned, we are short by roughly five lakhs of tons of nitrogen. In other words, we are at present producing food sufficient for the proper feeding of only two-thirds of the population.

How is our nitrogen position and how are we to set about for increasing the food supply?

Statement No. VI giving the number of livestock for all India including Indian States for the year 1929—30 and the amounts of nitrogen that may be conserved from their excreta.

Livestock	Number (rounded to thousands)	Nitrogen likely to be produced by a single animal in one year	Total amount of nitrogen.
		lbs.	Tons.
Human	353.000,000	6·7	1,055,848
Bovine-cattle & buffaloes	197,836,000	20·0	1,721,750
Bovine-goats & sheep	90,123,000	12·5	502,918
Horses and ponies	2,252,0 0	20·0	20,108
Mules, donkeys, camels etc	2,838,000	15·0	19,005
Total.			3,319,629

The statement shows the nitrogen position in regard to the available supplies. The nitrogen of the human excreta is not all lost and unutilised. Likewise the nitrogen contained in animal excreta is not all utilised. A little of the former and most of the latter are being utilised, as manure and so we may assume, that excluding the nitrogen of the human excreta, two millon tons of organic nitrogen are being used annually in the production of food and industrial crops.

On the basis of even as high a figure as twenty per cent nitrogen efficiency for grain, the present out-turn of food nitrogen connotes, on the whole, a satisfactory utilisation of the existing indigenous supplies. Further effort in the better conservation and utilisation of indigenous sources may not make up the food shortage at the expense of the industrial crops. How is the deficit to be made up? There are two ways of doing it One is by increasing the acreage under food crops, the other is by increasing the production per acre. According to Agricultural statistics of India in 1929—30 there were 155 million acres of cultivable waste other than fallow. How much of this land should be brought under cultivation to meet the present requirements?

From statements IV and V it is seen that 247 million acres give 1,071,138 tons of nitrogen per acre in food crops; or one ton of nitrogen is obtained from 230 acres of food crops. One person of the population would require 9'66 lbs. of nitrogen as food and so a ton of nitrogen would feed 230 persons. That is one cultivated acre of India would give enough food for one person. On this basis there must be 353 million acres under cultivation. We should, therefore, get a hundred million acres of waste land under the plough. Is this feasible or profitable ?

According to Slade the all-inclusive capital cost for a ton year of nitrogen is £ 70 to 100. From our experience with nitrogenous manuring for our soils, we may take nitrogen efficiency for grain production at 15% of added nitrogen. So that, every ton of nitrogen added in the shape of fertiliser on a good basel dressing of organic manure and adequate supply of phosphates would give enough food for 35 people. On this basis, taking the maximum value fixed by Slade and at one acre per head of population, the capital outlay for nitrogen production sufficient for one acre comes to nearly £ 3 or Rs. 45. Compare this with the capital outlay required for bringing an acre of waste land under the plough. It will surely be not less than Rs. 50 per acre under the most favourable conditions and even for rainfed crops and anything above Rs. 50 depending on the nature of the soil and the cost of providing for irrigation. Assuming for a moment the impossible, viz. that the nature of the waste land is such that the capital outlay for both would be the same, what should be our course of action ? Should we make efforts at producing improved strains of crops and at rational intensive fertiliser practice based on incessant scientific research on plant nutrition and reduce the area necessary for supporting one person ? Or should we increase our acreage by bringing under cultivation the so called available waste land and thus miss the present opportunity for fixing atmospheric nitrogen and commit ourselves and the coming generation to a serious handicap ? The answer is plain.

Sir Alfred Chatterton stated in his address to the South Indian Association, Science Japanese Agriculture supports one person

on less than a third of an acre. Such is not impossible for us in India. Our Botanists can and are producing improved seed to give at least an average increase of ten to fifteen per cent. A quarter of a century of experimental work has demonstrated that by rational manuring we can not only keep up the high yielding quality of the improved strains but also augment them with an average increase of at least fifteen to twenty per cent.

Recent work here and elsewhere has established the importance of organic matter in the soil both for quality and quantity of food crops. The essential point is to husband our resources of organic manures by the better utilisation of existing ones and by finding ways and means of preventing loss of material of manurial value from going out of the country. We may grow green manure crops and utilise every bit of organic manure for our food crops and use nitrogen fixation products for industrial crops, or we may use small dressings of chemical fertilisers on adequate basal dressings of organic manures. The course of action depends on whether a crop is to depend on rainfall or whether its water supply will be augmented by some source of irrigation. In any case there is need for the use of nitrogen fixation products and the case for manufacturing them in India is evident.

In regard to power, it would appear that the 'arc process' consumes about 8·35 to 8·4 kilo watt year while for the 'cyanamide process' it is 2·3 kilo watt year per ton of nitrogen fixed. That is, the consumption of power in the 'arc process' is about four times that in the 'cyanamide process'. If power is available at a cheap rate, the 'arc process' for the manufacture of nitric acid has the advantage of being direct and comparatively cheap. It is stated that the 'arc process' is advantageous in Norway, where power is available at £ 1·2 per kilo watt year. For the arc and cyanamide processes, the power should be available throughout the year as in these processes which depend on high temperatures the current cannot be switched off and on, daily as this would mean considerable loss in efficiency. Intermittent power will be useful in the manufacture of synthetic ammonia by the Haber-Bosch process in which the intermittent power can be used for the electrolytic production of hydrogen which is made to combine with nitrogen at about 600°C. under pressure.

In regard to the economic size of the plant for the production of nitrogen fixation products the Royal Commission on Agriculture have stated that the minimum manufacturing capacity of a commercial plant should be 1,50,000 tons of pure nitrogen or roughly three quarter million tons of ammonium sulphate. I may, however, point out, that of the nitrogen fixing plants in the world at the beginning of 1930 fourteen plants were of a capacity below 150,000 tons, the capacity of 12 plants was below 100, while there were five plants with a capacity below 20,000 tons. Is it not possible that what is economical and

practicable for other countries may be or may be made to be so for us also? At least there is a case for the immediate institution of nitrogen research laboratories in which chemists and electrical engineers should work in close collaboration and co-ordination and tell us definitely what the position is.

For the convenience of our Readers, we reproduce below the summary of the Presidential remarks made by Major Howard, Chief Engineer for Hydro-electric Development and which was published in a previous number of this journal (Vol. xx, No 11. P. 449). *Ed. M. A. J.*

Chairman's Concluding Remarks. Rao Bahadur B. Viswanath's enthusiastic advocacy has made me wonder whether there is any one else present in South India who would be able to present it so well as he. He has brought out very clearly the deficiency of nitrogen and how it is imminent on us to produce nitrogen. But to me the problem is how much to produce, how to go about it and how to make the people use the product that is manufactured. In my opinion the best process to be adopted here is the Arc process. The problem is also economic and must be interpreted in a much wider sense than the merely scientific. We have, at the start, to decide on giving a nationol orientation to this enterprise if it should be any economic success later on. What exactly I mean by nationalizing such industries can be illustrated by referring to Japan, and Italy, where great strides have been made in scientific progress on account of the Government taking a chief hand in such enterprises. I can also quote to you the instance of Egypt where two million pounds have been sanctioned for the erection of hydro-electric works on the Nile and another two millions for the manufacture of fertilizers. I am perfectly sure because they are state-undertaken that even this vast expenditure will be justified in bringing useful returns.

I am not very sure of Pykara being a suitable site. It is not merely from economic considerations but because also that it is not particularly suitable. Nearer to us we have Mettur, an ideal site in my opinion. It is not very safe to take our figures from Norway. Norway was the first to start nitrogen fixation electro-chemically and the figures are of pre-war days. Power in Norway is produced at £ 2 a kilo-watt a year. The Nitrogen Fixation Committee's finding is that this would be equivalent to £ 4 at present. We can produce at Mettur easily at and that with profit.

One thing however we must bear in mind and that is the competition from foreign markets. The Agricultural Commission went into this and it was this that made them argue against electro-chemical projects in this country. In the early stages at least, therefore, we must start with protection from the Government and in my opinion that is the only economic solution. I am in sympathy with the lecturer not merely sentimentally but also practically.

STUDIES IN POULTRY-KEEPING

Part I. SOME ADVANTAGES IN POULTRY-KEEPING.

By R. W. LITTLEWOOD,
Deputy Director of Agriculture, Live Stock,
and H. NARAHARI RAO,
Poultry Manager, Hosur.

Eggs and poultry for meat are the primary edible products for those who use them in their daily diet. During recent years the demand for poultry products has considerably increased, especially in places near towns. In such places people take so keen an interest that they are becoming specialised in poultry keeping.

Some people keep fowls for hobby, some for the sport of cock fighting and some to realise profit out of them. The subject of this short note is for those who want to keep fowls for profit. Fowls can be reared for home use also, and when there is a chance to realise a little profit from this branch of work there is no reason why greater attention should not be paid to it.

The birds are docile and easy to manage; therefore one's wife or children can look after them whilst the men are employed in their fields.

Poultry keeping is within the scope of everybody and even a small farmer can keep a few fowls with advantage. People even in big cities and towns with some available space at their disposal can maintain a few birds. This system is generally termed as "backyard poultry keeping". With a little attention, good accommodation, and proper feeding, this eventually becomes a source of a small income.

A good hen when fed and kept properly will eat about Rs. 0-5-0 worth of food in a month and will lay eggs worth about Rs. 0—11—0. So, by keeping 30 hens one can earn about a profit of Rs. 11-0-0 a month or Rs. 130 a year with a little trouble. Is not this income equal to the value of a crop?

It is distinct advantage to keep fowls in a small way in conjunction with general farming. The birds utilise enormous quantities of waste products, grains, and vegetables that are on the farm.

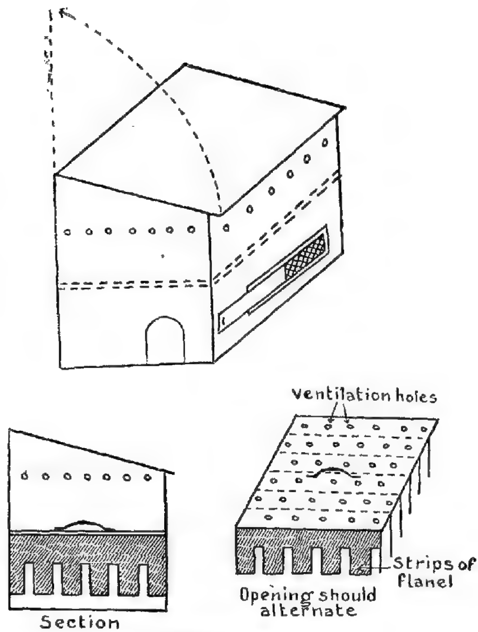
The birds can be put on the stubbles i. e., a newly harvested field and the fowls will eat the shed grains which would otherwise go to waste, thus converting all the waste material into edible product.

The birds eat the insect pests and grubs that may not be noticed by us in the fields and so assist to eradicate the pests which might damage the succeeding crop.

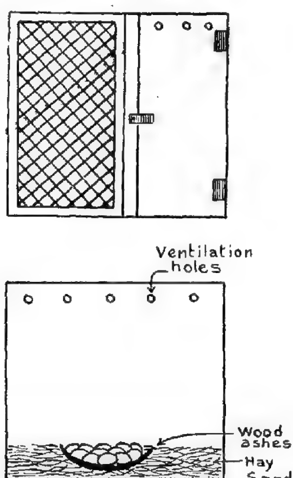
In the case of a young crop the birds can be let into the fields when the crop is a foot high. They will get plenty of worms, insects, etc. which would otherwise do a lot of harm to the growing crop. By this system, the birds get an unlimited range and so the food bill for the birds can be reduced considerably. Poultry manure is very valuable.

Poultry keeping as a side line to agriculture does really help the farmer in a variety of ways; so before deciding as to how this should be started, consult the Deputy Director of Agriculture, Livestock, Hosur Cattle Farm P. O. who will give all necessary help and advice.

At the Livetock Research Station, Hosur, there is a Poultry Section which maintains birds of imported and indigenous breeds. It is managed by trained men who are in a position to give advice to the visitors. The natural and artificial methods of incubation, artificial feeding and rearing of chickens, breeding and feeding of breeding hens,



FOSTER MOTHER



COOP FOR SITTING HEN

different systems of housing the birds etc. are all practised. Visitors are always welcome.

There is a great demand for birds and setting eggs and the farm supplies the needs of the public at a very low rate, as they become available. The breeds maintained are :—

1. White Leghorns,
2. Rhode Island Reds,
3. Light Sussex,
4. Black Minorcas,
5. Chittagongs,

and 6. Country birds.

The results for last year give the number of eggs laid in the pullet year by selected birds in each breed, as follows:—

Breed	No of hens.	Average egg yield in pullet year	Highest individual yield	Lowest individual yield
White Leghorns	12	184	236	158
Rhode Island Reds	9	157	181	135
Light Sussex	6	143	196	109
Black Minorcas	3	149	167	118
Chittagongs	3	134	149	116
Country (Tellichery)	5	110	141	85

Part II. BROODING AND REARING OF CHICKS

The brooding and rearing of chicks is an important branch of poultry-keeping, in as much as, it is the nucleus round which the whole enterprise has to be built. This may be classified as "Natural" and "Artificial". Towards achievement of success in this line one requires eternal vigilance, patience and attention to the smallest details.

Natural brooding and rearing. In the above method, man has taken advantage of nature's lessons and employed hens to brood and rear chicks provided they do not extend to an unwieldy number.

On being hatched out the baby chicks require, on first opening their eyes to light, absolute rest as they have had enough exertion in their hard struggle to wriggle out of the eggs. They should not be let out till they become active enough, and show a tendency to leave the nest.

A clean coop should be prepared and kept ready to receive the newly hatched out chicks which have to be tranferred with the mother hen. Whatever be the nature of these coops, the principles of cleanliness, freedom from damp and protection from extremes of weather conditions, should never be overlooked.

The mother hen should have free access to a dust bath which should have some disinfectant powder mixed in it to prevent lice etc. getting on to the chickens, which would worry them and reduce their condition resulting in their growth being stunted and consequently their turning out to be an economic failure.

The rearing capacity of a hen luckily exceeds her hatching capacity; taking advantage of this fact, a good mother can be made to foster from 15 to 20 chicks including those hatched out about the same time, from other hens. She knows by instinct the principles of rearing chicks and so, all that we have to do is to see to the importance of cleanliness, proper feeding, and protection from enemies such as hawks, kites, rats, mangoose, snakes etc. A small wire run will serve this purpose.

Inclemency of weather conditions affects the general health of the little chicks to a considerable extent, so, the following precautions are the more important of those which should never be neglected, in the selection of the place for the run. (1) Adequate sunlight, (2) Prevention of humid surrounding, such as wet grass patches, flooring etc., (3) Cold winds and draughts.

Artificial method of rearing. In intensive poultry farming, incubators have to be used to meet the large demand for chicks and recourse has to be taken to artificial brooding and rearing.

The natural way of rearing chicks has a distinct advantage, in that, it relieves us of a considerable portion of our responsibilities in attending to such details as the mother hen can do. When however the number becomes unwieldy, we have to necessarily depend on some mechanical contrivance that would successfully replace the mother hen providing the chicks all the comforts such as warmth, ventilation and space which she herself would have been in a position to give. "Foster mothers", "Brooders" and "Hovers" serve the above purpose.

The "Foster Mother" or "Brooder" is practically nothing else but a box in the chicken chamber which is heated by oil, coal or electricity, the temperature of which is adjusted by the flame in the case of oil.

The "Hover" is a cone shaped piece of metal with a lamp in the middle, stands over the chicks like a canopy and the heat is radiated down below.

There are several types of Foster Mothers and Brooders in the market and this aspect of the question depends on the magnitude on which a farm is run.

For small farms, where 50-60 chicks are reared at a time "Fireless Brooders" can be easily made locally at a small cost. Fireless brooders" are those which have no lamp burning in them. The main principle is to conserve the heat generated by the chicks themselves.

Description of "Foster Mother". For a unit of 35 chicks, take a packing case with the following dimensions 3′ long, 1′—9″ broad and 1′6″ deep. The lid of the box should be shaped like a lean to roof, Just below the lid, ventilation holes should be provided in a row. Chicks generally crowd in the corners and so the four corners should be rounded off with a strip of wood. About 10 inches above the floor of the box, there is a cardboard roof on a wooden frame which fits on ridges and to which are suspended a number of flannel strips as per sketches—the opening alternating. The floor of the box should have some litter in the form of chopped dry grass etc. The side of the box should have a ventilator 9″ x 3″ with a shutter which can be kept open or closed as necessity arises.

The number of chicks should be reduced as they grow older and in size: First week 35 to 40 chicks, Second week 30, Third week 25, Fourth week 20 and so on.

In this kind of brooder, care has to be taken regarding floor space. Too many chicks must not be put into this; otherwise they will be overcrowded and they will not thrive well and may start cannibalism.

This kind of Foster Mother is very good for the districts of this Presidency except Hill Stations.

Another kind of "Foster Mother" or "After Mother" as it is called is to get a box with a dimension of 4′ x 3′ x 2′. The inside of the box is lined with wire-netting and the space between the wire netting and the side planks should be filled in with hay, straw or dry grass. As the chicks grow older the material can be thinned gradually till at last the whole lot of it is removed. The idea is to conserve as much warmth as possible during the early part of the chick's life and graduaally lower the inside temperature as the chicks grow older. The chicks can remain in this "After-mother" from 5 to 8 weeks.

Feeding. Experience shows that mortality amongst chicks is greatest between the first and the third weeks; so all endeavour should be made to push them through this period successfully. At this stage of life, apart from adequate warmth and other comforts already mentioned, the ration of the chicks must be so regulated as to give them a good start in life to develop into vigorous birds.

They must be given sufficient food but not be overfed. There is no harm in their feeling slightly hungry which would keep them busy scratching about in search of food.

There are a few principles in nutrition, which must be observed in any system of chicken rearing. Rations for chicks should have necessary nutrients to produce sufficient heat and energy and to provide all that is necessary for growth.

The first feed for chicks should be some broken grain, finely cracked wheat or ragi or broken rice. If one can afford to get oatmeal, this is the best food for the first two weeks.

This should be fed on feeding boards within the easy reach of chicks. They should however, be taught to pick up their first food in the absence of the mother hen; this can be easily done by tapping the forefinger on the board; thus attracting the attention of the chicks to pick up the grains.

Hard-boiled eggs finely grated, mixed with bread crumps, should be given twice daily up to 2 weeks. Clean water should be available before them always. Skim-milk and butter milk are very good and can also be provided if possible.

Green-food. One important requirement for their growth is green-food and as such, this should be given when they are two to three weeks old. When the chicks have access for a free range on young grass, this need not be given.

FEEDING ROUTINE

Age of chicks.	Feed.	Drink.
Up to 36 hours.	No feed.	Keep them in warm brooder.
Baby chicks up to 10 days.	Oatmeal or ground oats or finely cracked maize or wheat or broken rice depending on the availability of the grain locally. 5 times a day: 6 A.M. 9 A.M., 11 A. M., 1 P. M. and 4 P. M. Feed sparingly & do not overfeed.	Clean water. Skimmilk or buttermilk diluted with water
10 to 20 days.	Grainfood as noted above; at 11 A. M. boiled eggs finely grated with shell, with bread crumps. White ants to be collected and given to them.	do.
20 days to 1 month.	Grainfood as noted above but cracked a little bigger. Leaves of vegetables can be hung before them for picking. Fine shell grit and charcoal should be available before them always.	Clean water, Skim-milk or Butter-milk diluted with water.
4 to 6 weeks.	Grain foods as noted above-feed 3 times bigger grain. Shell grit and charcoal as above.	do.
6 weeks to 3½ months.	Mash. *Stock Mash.* 30 lb. Wheat bran. 30 lb. Ricebran. 30 lb. Ragi flour. 10 lb. Groundnut cake. 10 lb Fis meal. 3 lb. mineral mixture. 1 lb. Salt. Mix 2 parts of wheat bran to the above stock mash up to 2 months and 1 part up to 3½ months, and any green vegetables to be chopped and mixed with wet mash. Cooked rice and beef on alternate days for chiken after one month. Shell grit and charcoal should be available before them always.	do.

Drinking water:—Add Permanganate of Potash to drinking water to give it a light red colour and change the water as often as possible; use an earthern vessel and keep it always in shade.

Give the chicks fresh grain, ground each day in the sun.

Vices. Lack of sufficient space, overcrowding, underfeeding, want of mineral matter, leaving about the weaklings which are not able to hold their own, large variations in size of the in-mates etc. are the factors which are responsible for toe-picking and cannibalism. Most of the above are easily prevented with a little attention and care. Sexes must be separated as soon as recognised.

Perching. The chicks should be perched as scon as possible They get better ventilation, there, than is obtainable when they are on the floor.

Conclusion. In conclusion, it must be stated that there is no hard and fast rule with regard to these little things and that common sense and experience alone play the most important part in the enterprise in turning out to be a success.

(*To be continued*)

FLUE CURING AND GRADING OF TOBACCO IN THE GUNTUR DISTRICT

By P. GOPALARATNAM, L. Ag.

Cotton Assistant, Agricultural Research Station, Guntur.

Introduction. Tobacco (*Nicotiana tabacum*) is a native of Mexico and Brazil (Watt 1908). It gained popularity all over the world by its gradual introduction and acclimatisation. The area under the crop in the Madras Presidency is 268,815 acres, of which the Guntur District contributes a third. The crop being an industrial one, is put to varied uses and i broadly classified into (a) cigar wrapper tobaccoes (b) cigar filler tobaccoes (c) pipe tobaccoes and (d) plug tobaccoes. Tobacco in the cured state is chiefly exported to the United States of America and is imported in the form of finished products like cigarettes; decoctions; active principles; medicines etc. Madras and Burma contribute their bulk quota in the export of manufactured cigars to Maldives; Straits; Ceylon and Arabia (Watt 1908.)

There are three distinct classes of persons connected with the tobacco trade viz., (1) cultivators (2) curers and (3) dealers. The present article is mainly confined to the work of the second class of people though the same embraces in a way the work done by the last-mentioned class of persons.

Of the three methods of curing tobacco, sun-curing; air-curing, and flue curing, the one mentioned last is gaining ground with the cultivators of this district as evidenced by the number of curing sheds or barns increasing every year. At present, the number is about 1400 in the Guntur District.

Flue curing is adopted for the manufacture of cigarette tobacco and the tobacco intended for cigarettes should have the following qualities:— (1) The leaves should be thin and obtained from a plant with short internodes having maximum number of leaves; (2) The leaves should be fairly broad with short veins so that the cigarette paper may not be damaged during the course of manufacture (Howard 1913): (3) The leaves should be light yellowish-green in colour so as to acquire a golden yellow colour on curing; (4) The leaves should not become spongy or burnt by the process of curing, but should have good texture and fine flavour. Only exotic types of tobacco like Adcock, Virginia and Harison Special are suited for the purpose, though local types grown in particular localities are used for blending.

In the Guntur taluk, there are some typical centres which produce genuine tobacco of both the local and the exotic types. These are Thadikonda, Neerkonda, Parimi, Yerrapalem etc. In the above places, tobacco is raised in rotation with paddy (*Oriza Sativa*). The places are annually deposited with silt as they are subject to inundation. The crop that is intended for flue curing is allowed to flower and set seed freely. This practice facilitates the plants to produce thin leaves as the nutrition is allowed to run into the inflorescence for the development of the fertilised ovaries. The local belief is that the crop will produce the desired quality of leaves if heavy rains occur when the plants commence the gummy exudation. The crop under consideration is raised only under rain-fed conditions.

Barns. The Barns of the Guntur District are of two sizes viz., (1) the full-sized ones with two stoves and (2) the half-sized ones with single furnace. The walls are constructed out of rough stone or brick, in lime-mortar or mud, as the case may be. The roof is provided with corrugated galvanised iron sheets. Except for the ventilators, the door and glass panes fixed in the walls, the rest of the portion is air tight. The inner floor space is twenty feet square with five 'rooms' and twenty-nine compartments. A 'room' is a vertical space included between two sets of tier poles extending from one side of the barn to the other. These tier poles are of Casuarina (*Casuarina equisetifolia*) and are placed about four feet and ten inches apart horizontally and two feet apart vertically. The barns are constructed in several sizes and different heights, but the one mentioned above is a typical one. The body of the barn with 400 square feet of floor space contains five rooms across and 5, 6, 7, 6 and 5 compartments to suit the ridged roof above. Starting from one side of the barn the number of compartments gradually increases till the middle room which comes just below the pitch of the roof and decrease with the slope of the roof as indicated above. Split bamboo sticks of four feet and ten inches length with the tobacco leaves hanging, are usually kept eight inches apart such that each tier will hold thirty sticks. In practice,

the number of sticks kept per each tier is much more than the desired number. The roof tiers hold about 200 to 250 sticks according to the availability of space. The entire capacity of the barn provides space for about 1100 sticks but the barn should not be over-stuffed lest it should prevent proper functioning. In times of need, instances of increasing the number of sticks up to 1,200 and 1,500 are not rare. The lowest tier upon which the green tobacco is put is about eight to nine feet from the floor. For a single charge, the produce of two and a half to three acres can be arranged in a barn of the above-mentioned specifications.

General aspects of curing. Curing of the tobacco leaf is a life process and the activity of the cells is impaired by improper manipulation. The whole process is a delicate one and requires the handling of an experienced expert. The method of doing it varies with the kind of leaf grown and the object for which it is to be used. The process of curing is very much influenced by the structure of leaf and the created artificial surroundings of temperature and moisture. The method of curing has to be regulated with the type of tobacco and no rule-of-thumb method can be given for all kinds of tobacco. The process of curing which might be best suited for cigarettes, will be detrimental for the one meant for cigar manufacture. However minute and valuable the instructions may be, for the regulation of heat at different intervals of time, they cannot as a whole be followed in practice, but require timely judgment and modification to suit the change of conditions. The rapidity of curing should be regulated, to suit the type of leaf in such a way that the delicate cells of the leaf are prevented from losing the juices which give flavour and suppleness to the cured leaves. If the process were to be taken at a rapid speed, the leaves get burnt and pole-sweated. The curing is effected by artificial heat created by burning coal in the furnace and allowing the heat to radiate through metal flues arranged as shown in (fig. 1). A thermometer is kept inside the barn so as to determine and regulate the degrees of heat required at the various stages of the curing process.

Coming to the plant it is always safe to arrange the leaves in the barn on the day of cutting, lest the leaves should become wilted. Even a difference of one day either in cutting or curing will not produce uniform colour.

Killebrew (1928) says that "curing tobacco yellow is now regarded as an art which demands the closest attention, the best judgment, and the most painstaking experience, to attain perfect results. No novice can succeed without undergoing an apprenticeship, however minute in details the instructions he may receive be."

It is always safe for any curer of tobacco leaf to watch a particular plant and thereby exercise judgment as to when to increase or decrease the heat.

According to Regland's method there are four stages in the operation of curing the tobacco leaves.

(a) The yellowing process:— Requires 90° F. of heat lasting from 24 to 30 hours.

(b) Fixing the colour:— Requires a temperature ranging from 100° to 120° for 16 to 10 hours.

(c) The curing process:— Requires a temperature of 120° to 125° for 48 hours.

(d) The curing of the stalk and stem:— Requires a gradual increase of heat by five degrees from 125° to 175° in the course of 9 to 10 hours.

Reddening or sponging of the leaves occurs during the second stage and so it is always advisable to take the process slowly and prevent the air from getting in, lest the tobacco leaf should get sweated before fixing the colour.

It is stated by Regland that approximately one pound of water must be driven out from each plant in the course of 100 hours. Under Guntur conditions it takes four to four and a half days to finish one charge according to the prevailing weather conditions.

Details of curing. The stripping of the matured tobacco leaves is usually done in the evening, and the leaves are heaped in the field. They are removed to the nearest barn the next morning, and stringed on to the bamboo stricks four feet and ten inches in length as shown in (fig. 2). During stringing the stricks are mounted on 'horses'* and two to three leaves per loop are inserted and the string is tied to the stick. A barn of the above dimensions can hold about 1,100 sticks and it requires ten to twelve coolies for stringing and arranging the sticks on the firing tiers. If the work were to be started at 6 a. m., the whole work of stringing and arranging the sticks in the barn will be completed by 3 to 5 p. m., according to the dexterity of the labourers. To get good results, the sticks are kept eight inches apart on cool days, and at ten inches apart on warm days. The fire is started at once by lighting the coal in the furnaces, and all the bottom and top ventilators are closed. The inside room temperature will be about 88° F. The temperature is then raised to 90° F. and is kept at that stage for two hours when it is raised to 95° F. and kept for ten hours. From that it is raised to 100° F. It is then the yellowing of tobacco commences. Once again the temperature is raised to 105° F. and the top ventilator is opened to half of its capacity. Gradually the temperature is increased to 115° F. and then the top ventilator is raised to the full. Simultaneously the bottom ventilators are raised by two inches from the wall. The leaves begin to sweat between 100° to 115° F. and the water contained in the leaves along with the foreign matter commence evaporating. The ventilators at the bottom are raised for allowing the cold air to get in, for half to two hours,

* A wooden frame of two vertical posts to support the sticks.

PLAN OF THE BARN

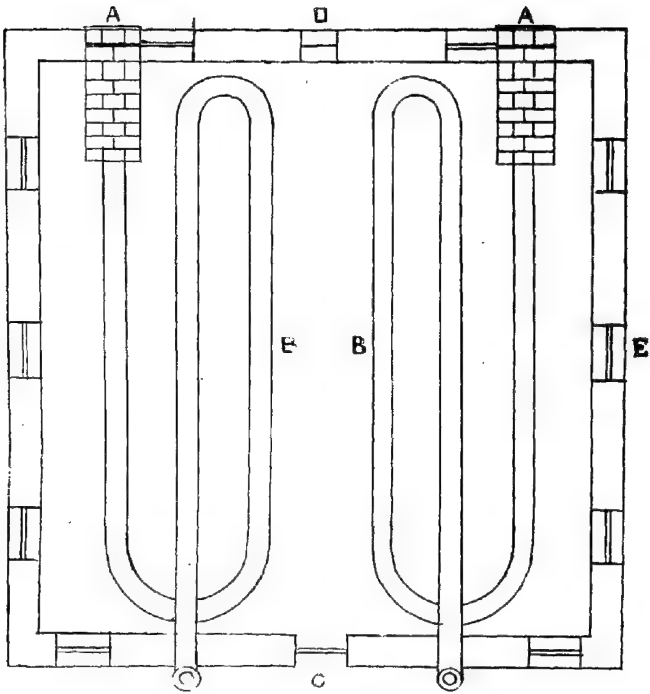


Fig. 1.

Ref:— A = Stove. B = Metal flues. C = Door.
D = Glass Pane. E = Ventilator.

METHOD OF STRINGING TOBACCO LEAVES

Fig. 2.

according to the quality of leaf, and the prevailing atmospheric conditions outside. At this stage, the leaf is watched very carefully and when it has become sufficiently yellow, dry heat is once again created and is advanced by five degrees at a pace sufficiently rapid to prevent the leaves from sponging but not so much as to splotch them. With this end in view, one has to use his experience to regulate the temperature, right along the process of curing.

By the time the temperature goes up to 135° F. all the leaves dry up, but the veins contain moisture The temperature is advanced as fast as the leaves can bear and is allowed to remain for a few hours at 135° F. This is done as a precautionary measure. When the sponging stage is passed, the temperature is raised to 140° F. and kept there for three hours. By now, the percentage of moisture contained in the leaves will be very little.

The temperature is then raised to 145° F and the shutters are lowered down to half of their full capacity. The same temperature is maintained till the leaves become completely devoid of moisture. By then, the stalks also get dried up to half of their length. The temperature is then raised to 150° F and kept so for five or six hours. It is then the side ventilators are closed completely. After maintaining the temperature at 160° F. for three hours, the top ventilator is lowered flush with the opening in the roof. For getting the veins and stalks dried, the temperature is raised to 165° F and even at that temperature, if they do not dry up, the temperature is raised to 170° F. at a time when one feels confident that the entire leaf gets dried in the course of ten hours.

The raising and lowering of temperature is manipulated by the addition of coal in the furnace, and the opening and closing of dampers and eyepieces of the stoves. When the dampers are kept open with the eyepieces closed, the outside air gets into the furnaces through the gratings and raises the temperature. On the other hand when the dampers are closed and the eyepieces are kept open, cool air gets direct into the furnaces and retards the burning of coal whereby the temperature is reduced. It takes nearly four to four and a half days to finish a charge and the coal consumed per charge works to one and a half to two tons on an average. The cured leaves are removed with the sticks, and are kept suspended under shade overnight. Early next morning they become soft when they are heaped. The heap is disturbed on the day of stuffing them, either in gunnies or dealwood cases as the case may be. If sufficient yellowing is not obtained in the process of curing, it is improved a bit during the fermentation that takes place in the heaped state. The heap should be covered and the surroundings kept cool lest the leaves should become brittle.

The salient features of flue curing are :—

(1) Leaves should be arranged in the barn and the coal in the furnaces lit before the leaves get wilted.

(2) The bends of the flues should be gradual and well curved instead of their being abrupt or bent at right angles, for the free circulation of heat and smoke

(3) For proper functioning, barns should not be overstuffed.

(4) In general, raising of temperature should be well regulated instead of too rapidly.

(5) Planks should be suspended over main flues in order to keep off the evil effects of direct heat and to prevent the scalding of the tobacco leaf kept on the lowest tiers.

(6) For sweating the entire produce in the barn, pans filled with water should be kept on the main flues for supplying warm vapour.

(7) Letting in air at the time of yellowing should be checked lest the leaf should sweat before complete drying.

(8) For regulating the temperature only one particular plant should be watched instead of seeing random leaves.

(9) The coal used must be of good quality to raise the temperature steadily and to maintain it.

(10) The flues must be kept in a perfect plane for the uniform radiation of heat.

Grading. Grading or the assorting of cured tobacco leaves into different classes according to the quality and colour of leaf, forms the work of the dealer in the tobacco trade. Yellow tobacco is usually graded into five classes and the quality of leaf under each class is as enumerated below :—

1st Class :— Leaves with good texture and of bright golden yellow colour.

2nd Class :—Leaves of bright yellow colour with green veins.

3rd Class :—Leaves that have become spongy and the leaves with green margins of varying intensities.

4th Class :—Leaves that have become reddened and those with deep green patches.

5th Class :—Broken and spoiled leaves which are locally known as "*Gullaku*".

The local dealers of the Guntur District are of two classes viz., (1) Indian firms exporting the tobacco to foreign countries and (2) Agents of the foreign firms exporting tobacco. In years of good demand all the above mentioned five grades of tobacco leaves are purchased by the local dealers, but in other years only the first four classes of tobacco are purchased by the firms. In the Guntur District, the dealers purchase cured tobacco both in the graded and the ungraded state. In the latter case, they get the stuff graded before exporting. To get a candy of cured leaf graded, the labour of ten to twelve women coolies is required. Usually it is given on a contract rate ranging from Rs. 3 to Rs. 3-8-0 per candy. The leaves after they are graded by the ordinary coolies, pass on to the expert coolies who are known as table supervisors, who rectify the mistakes of the former in the proper assorting, and after this the leaves of different

classes are packed separately in dealwood cases for export. The prices of the graded stuff during the current year are,

	Value per lb.			per candy of 500 lbs.		
	Rs.	As.	Ps.	Rs.	As.	Ps.
1st Class	0	9	0	280	0	0
2nd ,,	0	7	0	220	0	0
3rd ,,	0	5	0	150	0	0
4th ,,	0	3	0	90	0	0
5th ,,	0	1	0	30	0	0

The rate for the ungraded stuff is Rs. 150 per candy.

Economics.

Balance Sheet of the tobacco cultivator:

	Rs.	As.	Ps.	Rs.	As.	Ps.
Cost of production of tobacco per acre				50	0	0
Cost of curing carting etc.				60	0	0
Value realised from one acre (i.e.) two candies of cured tobacco leaf at Rs. 150 per candy (ungraded)	300	0	0			
Difference in value				200	0	0
	300	0	0	300	0	0

Net profit realised from one acre of exotic tobacco variety............Rs. 200.

Balance sheet of the tobacco curer:

	Rs.	As.	Ps
Capital outlay:—			
Cost of constructing a full-sized barn	750	0	0
Cost of furnaces, metal flues, thermometer sticks etc.	250	0	0
Total	1000	0	0

	Rs.	As.	Ps.	Rs.	As.	Ps.
Annual depreciation taking the life of a barn to be ten years				100	0	0
Interest on the capital outlay at 6% per annum				60	0	0
A single barn can have 20 charges in the season lasting for 3½ months since each charge takes 4 days for completion.						
Cost of coal for 20 charges at a rate of two tons per charge and the cost of coal being Rs. 15 per ton.				600	0	0
Labour of an experienced director on Rs. 20 per mensem to manage two barns and Rs. 12 for an attender to manage a single barn, for three and a half months.				77	0	0
Labour for stringing, arranging and removing tobacco leaves from the barn etc. for 20 charges at Rs. 12 per charge.				240	0	0
Petty repairs.				10	0	0
Erection of thatched pandal and shed for keeping cured tobacco.				50	0	0
Value realised for 20 charges at Rs. 130 per charge.	2600	0	0			
Difference amount.				1463	0	0
Total	2600	0	0	2600	0	0

Net profit per season of 3½ months (in round figures) Rs. 1400.

Of late curing yellow tobacco has become a profession for the non-Agricultural capitalist of the Guntur District and hence the number of barns is increased by hundreds every year.

References.

(1) *Howard Gabrielle* (1913) *Mem. Dept. of Agri. Ind. Bot. Ser.* Vol VI pp. 26

(2) *Killebrew and Myrick* (1928) *Tobacco leaf.*

(3) *Regland* *Curing tobacco leaf in Virgina.* (Quoted by Killebrew and Myrick)

(4) *Watt* (1903) *The Commercial Products of India.*

THE VALUE OF SCIENTIFIC RESEARCH TO AGRICULTURE. *

By Secretary HENRY A. WALLACE,

U. S. Department of Agriculture.

I appreciate that it is often difficult for the layman to see any earthly use in many of the things that scientists do and talk about doing. Of what value is it to you and to me, for instance, for a man to spend his time trying to discover the workings of nature? How can a man—we are inclined to say—do any thing useful unless he works directly with the things that we all can touch and see, that we know have practical utility?

Well, when confronted by questions like that, I think of men like Faraday and Mendel and some of the scientists in the employ of the Federal Government. About a hundred years ago in England Michael Faraday was what we might call an experimental philosopher. He never concerned himself with the invention of machines. His sole aim was to learn something about the workings of nature. He discovered the principle of electromagnetic induction, and if you remember your high school science, you will recall that without that discovery we would today have no means of putting electrical energy to work for us. Without Faraday, the amazing inventions of Edison and Marconi would not have been possible, and your radio and your electric lights would not exist.

And Mendel, that cloistered Moravian monk who whiled away the hours studying plants and experimenting with the cross-breeding of varieties of garden peas—of what earthly use was all that? He did it because it interested him. But was it of any use to the rest of us? I can assure you that it was, for the principles he discovered have been employed by the plant breeders of to-day in developing more productive varieties of every plant that feeds and clothes you. Scientists like Mendel and Faraday were working in what we call pure science. They were trying to discover nature's fundamental secrets, but without thought of any practical application of their discoveries. Had some overzealous administrator tried to restrict their curiosity to some specific object, or the immediate solution of some highly practical problem, we would have been deprived, in all probability, of their great discoveries.

It falls upon another group of scientists to apply these basic principles to the pressing problems of the world and turn them to practictal account. Thus most of the scientific research in Government departments is applied science. The surprising thing, however, is that even in the field of applied science far-reaching discoveries are made, often as a by-product of the immediate task.

* (Extracted from Science, May 19, 1933)

One of the most famous examples was the discovery by scientists in the Department of Agriculture some forty years ago, that a micro-organism found in the blood of cattle is the cause of splenetic fever, and that the disease is transmitted by the cattle tick.

These scientists—by name Theobald Smith, Curtice, Kilgore and Salmon—of course had no idea of the far-reaching consequences of their discovery. They were intent on finding the cause of a cattle disease, not in discovering a fundamental principle in medicine. But that happens often in scientific research.

And at other times, a scientist may fail to solve one problem, only to solve another, unexpectedly. Not long ago some Chemists in the Department of Agriculture were examining molds—fungous growths, that is—to find one that would produce tartaric acid Patiently they tested one after another, until they had exhausted the possibilities of 149 different molds. Finally the 150th rewarded their long search with success—but not the success they were expecting. Instead of producing tartaric acid, the 150th mold unexpectedly produced gluconic acid. This is now used in making calcium gluconate, the only calcium salt that can be injected between the muscles, without causing abscesses, treating certain human diseases. This salt used to cost 150$ a pound. As a result of this research it may now be had for 50 cents a pound.

In one way or another, I have said, every farmer in the United States is farming differently to-day because of the scientific discoveries resulting from state and federal appropriations. To be specific and as up-to-date as possible, suppose we run down the list of research achievements reported by one bureau of the Department of Agriculture for the past year. Before me is a summarised report for the Bureau of Plant Industry and among their accomplishments I find these items:

Established the superiority of five new hybrid lines of corn in Iowa tests; released, for the use of growers, two new lines of hybrid sweet corn that will be resistant to bacterial wilt; released, for the use of growers, a new wilt resistant variety of tomato, known as the Pritchard; introduced a new blackberry variety the Brainerd, especially adapted for the West and South, and also introduced three improved varieties of strawberry; developed new root-stocks for Satsuma oranges, and found new disease-resistant stocks for California grape vine-yards; introduced a new sugarbeet, U. S. No. 1, that is resistant to the costly curlytop disease, and that also greatly outyields older varieties; tested some promising new sugarcane seedlings, crosses of American and New Guinea varieties; reported distinct progress in breeding alfalfa that will be immune to bacterial wilt, developed a new variety of Egyptian cotton in Arizona.

As another part of its job, this bureau investigates the storing, handling and processing of foods. For the year under report the bureau scientists discovered among other things, that putting apples in cold storage immediately after picking almost completely prevents soft scald; that adding sulphur-dioxide to the sawdust packing of grapes retards the development of mold; and that treating fruits with carbon dioxide before shipment is as effective as pre-cooling in preventing spoilage.

That is a partial report of the research accomplishments of one bureau. It gives point to the statement that research can stabilise crop production and eliminate or reduce those hazards—of disease, of climate, even of soil—which make agricultural production uncertain. For it remains true that though drought or disease or insect pests may raise the price of a crop by reducing the supply, such higher prices are cold comfort to the particular farmer whose cotton has been destroyed by the boll weevil or whose wheat has been hit by rust. I have, I think

a proper scientific respect for insects and diseases, but I question whether we ought to leave it up to them to determine the size of our crops and the level of our incomes. Nor can I forget that every year, according to Dr. L. O. Howard, the damage wrought by insects nullifies the labor of a million men.

If time and your patience permitted, it would be possible to cite instances to show how research has affected all our major farm crops and classes of live stock, how the patience, the skill and the informed imagination of scientists employed by the Department of Agriculture have altered the Agricultural map of this country and modified the farm practices of every farmer in the land. Many farmers are not aware of this, for the results of research reach the individual farm by an intricate, devious path, but they get there just the same.

If you will agree with me on that, I suspect you are at the same moment questioning whether this research has proved to be an unmixed blessing. For science and invention, you will say, have not only made it possible for us to produce enough to go around; they have made it possible for us to pole up towering surpluses, which in turn seem capable of bringing our whole economic system crashing down around our ears.

We cannot deny that when scientists in the Department of Agriculture develop a variety of wheat that produces five bushels more per acre than the variety commonly grown, one result may be, and often is too much wheat. When our modern knowledge of nutrition enables one bushel of corn to go as far as two bushels did in the pioneer days in feeding live-stock, one result may be too much pork and lard Of late years the Department of Agriculture and the Colleges have been aware of the problem. They have tried to meet it by helping the individual farmer adjust his own production to changing market needs. They have hoped that advice and complete information on supply and demand would suffice. Where they have been remiss, in my judgment, is in declining to face the fact that the individual farmer cannot adjust his production intelligently, unless he knows, with some degree of certainty, that his neighbors will do likewise. And it is to face that fact realistically that the new farm bill has been drafted. The essence of it is collective action, by all the producers, to accommodate their production to the market that actually exists.

Our expenditures for science, our efforts at increasing productive efficiency have in no sense been unwise. Certainly no thoughtful person could approve the abandonment of scientific research, or the relegation of our machines to the ash-heap. To do that would be like abandoning the use of automobiles because we have automobile accidents. As a rule, the fault is not with the automobiles but with the driver

It is not the fault of science that we have unused piles of wheat on Nebraska farms and tragic breadlines in New York City at one and the same moment. Rather it is because we have refused to apply science to the development of social machinery, machinery that will regulate our economic system to the end that what we produce can be equitably divided.

I am not one to ask for less efficiency. I want more, and I know that we can get far more. But I want the efficiency to be controlled in such a way that it does more good than harm. I want to see the farmers of the South grow 300 pounds of cotton per acre instead of 150 pounds, and the farmers of the North 50 bushels of corn per acre instead of 35 bushels. I want to see the average milk cow yield 400 pounds of butter fat per year instead of 200. And I see no reason why our hogs eventually should not produce 100 pounds of pork on the average from 6 bushels of corn, instead from 9 bushels.

These things can all be done. The research now going on will make it possible, and will pave the way for countless new agricultural achievements as well. Only the other day I learned that research now in progress indicates that crops grown in some regions of the nation have a higher nutritional value than apparently similar crops grown in other areas. If further study bears this out, the consequences will certainly be far-reaching. We may have a new agricultural map a decade from now. The research job, far from being done, is only well begun. We shall need new varieties of cereals and grasses to resist diseases better than those we now have. We shall have to keep cutting costs of production by increasing yields per acre. Methods of cultivation, like methods of feeding and managing live-stock, must be subject to continuing investigation if we are to keep abreast of the continually changing economic world about us.

When our Chemists, not long ago, discovered an economical method by which bagasse, a sugarcane waste, could be made into high quality cellulose, suitable for rayon, we patted ourselves on the back for an achievement of considerable importance. But over in the Bureau of Chemistry and Soils is a small bottle of a brownish cellulose substance called lignin, which was derived from the corn plant after many years of experimentation. The chemist will tell you that lignin is one of the principal parts of woody plant tissues; that it can therefore be obtained in abundance and it may yield a startling new collection of products. Already he has discovered in lignin such compounds as phenol and creosol Lignin may yet rank, in its rich potentialities, in its influence on disposing of farm wastes, with our major chemical discoveries.

No, the job of scientific research in Agriculture is not over, nor will it ever be. But to-day we have a new job a new field for experimenting—that of social control. Research to increase productive efficiency, to widen markets, must continue. Eliminate the less important research activities, in deference to the need for economy; get rid of the dead wood in our scientific organizations—but keep the men of science at the tasks which will always need doing. And add to the old job the one that has been begun so well, this new job of developing the machinery of social control.

Notes and Comments

I. **The Problem of unemployment**. We commend to our readers two schemes proposed to solve the problem of unemployment. One is that of the Director of Agriculture, Bengal, and the other a similar one from the Director of Agriculture, Mysore. The Bengal scheme instituted in 1928 at the Government Agricultural Farm, Faridpur provided for the employment and training of twenty educated middle class young men of all castes. These were taught the ordinary avocations of an average Indian agriculturist on a scientific basis. They were paid twelve rupees a month. Treated as ordinary farm labourers, they are required in all respects like the other farm-labourers to perform with their own hands all such operations as ploughing, laddering, weeding, jungle cutting, carrying baskets of manure, cleaning cattle-sheds, transplanting paddy in mud, cutting and steeping jute and extracting fibre therefrom for which operation they had to stand in water for hours together. They were not permitted to draw any allowance from their homes, although all of them invariably belonged

to respectable families. They had to attend to their own needs without the aid of servants. After a year's training of the kind, they were given three *bighas* of land rent-free for the first three years and a loan of two hundred rupees with which to purchase agricultural implements. The only condition imposed was that they should not employ any labour but should till the lands themselves. At the end of three years, a ryotwari settlement was made in their favour.

The scheme proposed in Mysore is also a similar one and the lands granted to young men are situated in the New Irwin Canal irrigation system. In these days of keen competition among University educated men there is nothing so profitable as going back to the land, to realise the dignity of manual labour and earn an honest living which Mother Earth will always supply. We are sure the Madras Government would also adopt a similar scheme in the wake of the special courses in Agriculture they have recently instituted at the Coimbatore Agricultural College.

II. **The Indian Sugar Conference.** A Conference in connection with the subject of sugar in India was held at Simla on the 10th instant to discuss various important items connected with the sugar industry and its future in India. It was a well represented gathering, including members from almost all the provinces including administrative heads, scientific and technical experts, capitalists and all others interested in this important subject. It was presided over by Sir Fazli-Hussain. The following were among the more important questions that are arranged for discussion at this conference.

(1) whether, having regard to the present demand for sugar in India and its possible expansion in the future, the present rate of development of the sugar industry is satisfactory, excessive or inadequate;

(2) whether either the sugarcane growers or the sugar manufacturers are unduly benefitted at the expense of the consumer and whether the benefits of protection granted to the industry, are being fairly distributed between the different interests;

(3) whether in the interests of the sound development of sugarcane cultivation and of the sugar manufacturing industry, it is desirable and practicable to regulate the relations between sugarcane growers and sugar manufacturers by zoning, licensing of factories, fixation of cane prices or other means;

(4) whether legislation is necessary for the better regulation of the Indian sugar industry, and if so to what extent such legislation should be central and to what extent provincial.

We have no doubt that as a result of this important conference the sugar industry in India will surely have a very prosperous and bright future.

III. The College Day and Conference. We very much regret to have to announce to our readers, members, and well wishers that the College Day and Conference proposed to be convened this month had to be unavoidably and unexpectedly postponed to some time in September. This is due to the fact that our president-elect Sir T. Vijayaraghavachariar had to leave for England and may not be able to be in Coimbatore before September. As we are very anxious that we should not miss the opportunity of securing such an experienced and able gentleman occupying an important position in relation to agriculture as Sir T. Vijayaraghavachariar we have proposed this postponement. We hope our action in doing so will be appreciated. The exact date of the conference and connected functions will be announced in due course.

ABSTRACTS.

A milk calculation formula for use at Tropical temperatures. Herbert Hawley (*Analyst, 1933, vol. 58, pp. 272—274*). As Richmond's milk-calculation formulae have been worked out for 60° F and thereabouts and are suitable for "temperate" climates only, the author has, as a result of numerous analyses, worked out the following formula which is claimed to hold good for tropical temperatures (about 85° F):—

S. N. F. = 0·2872 G/D + 0·328 F, where S. N. F. represents the percentage of solids not fat, F the percentage of milk fat, D, the specific gravity as determined with a glass vessel in air at 85° F. compared with the weight of water held by the same vessel at 60° F., and G. is 1000 D.—1000. The formula has been tested on many hundreds of tropical milk samples and works equally well for Madras cow and buffalo milk. It usually gives results for genuine milk accurate to 0·2 % of solids not fat. Errors exceeding 0·2 % are almost invariably associated with milks containing a large proportion of added water. Tables are given for 0·2872 G/D and 0·328 F to simplify calculation of result, but corrections for deviations of temperature from 85° F are not stated. (C. N.)

New Experiments in Electrofarming. S. S. Nehru (*Bulletin No. 62. of the Dept. Agriculture of the United Provinces, 1932*). These experiments are in continuation of work already reported in Bulletins Nos. 53 and 61 of the U. P. Dept of Agriculture and the results confirm previous findings that plants both in the vegetative and seed condition respond powerfully to light doses of electrocultural treatments like radiomagnetic beds, sparking treatment, violet-ray and X ray application etc. Cotton seed subjected to X ray or radiomagnetic treatment grew well at 6,700 ft. altitude and bolled profusely while the non-treated seed does not grow under the conditions. Resistance to pink bollworm and root-rot was greatly increased by the electro-treatment of cotton seed. Provision of radiomagnetic beds and sparking of seed markedly improved the quality and yield of vegetable crops like cauliflowers, peas, onions, pumpkins, carrots, beans, chillies etc. Badly mildewed rose plants when surrounded by radio-magnetic wire netting, recovered and produced bigger flowers than normal healthy plants. The effect of electro-cultural treatment of the seed of Barley, peas, and mustard was found to persist even in the fourth generation, where the treated plants ripened atleast one month before the controls. The Bulletin gives details of tests made with numerous other plants and quotes successful results obtained by other workers experimenting with the method in other provinces of India. (C. N.)

Two systems of feeding Dairy cows.—High Roughage and Low Grain versus Low Roughage and High grain. J. B. Lindsey and J. G. Archibald. (*Bulletin No. 291 of Massachusetts Agri. Expt Station, 1932*) This bulletin reports the results of an investigation, extending over three and a half years from 1928 to 1932, on the relative merits of two systems of feeding Dairy cows. One of these systems involved the feeding of a relatively larger amount of roughage and a smaller amount of grain; the other involved the feeding of a relatively smaller amount of roughage and a larger amount of grain. Two batches of Holstein cows, nine in each batch, were fed, "the high roughage" group with approximately one pound of grain for each 4½ pounds of milk produced, 35 pounds of silage and as much hay as they would clean up; and the "low roughage" group with approximately one pound of grain for each 2½ pounds of milk produced, 20 pounds of silage and hay as above. The following inferences were drawn from the comparison:—(1) The cows in the low roughage group maintained their general appearance rather better and made larger gains in weight than did those receiving a relatively large amount of roughage. The latter tended to be thinner and more rough coated. (2) The cows in the low roughage group produced more milk on both a daily and a yearly basis. Their lactations were slightly shorter but so also were their dry periods, so that their average productive period per calendar year was slightly higher. (3) The cows in the low roughage group made slightly better use of the feed they consumed as evidenced by the fact that they required 7% less dry matter and 27% less digestible nutrients to produce 100 lbs. of milk. (4) The cows in the low roughage group maintained their milk production from year to year somewhat better than did those in the high roughage group; the former were somewhat nearer normal in productive function than the latter. (5) Regarding the economics of the two systems feed, cost of milk production was practically the same for both groups. The higher roughage system, however, involves a smaller cash outlay; and an additional saving may be effected where that system is used, if the farmer is able to grow his roughages for less than the current market price. As a result of their experiments the authors conclude that in order to keep cows looking well and producing somewhere near the limit of their ability, reasonably liberal grain feeding must be practised.

(C. N.)

The Chemical Composition and Nutritive Properties of Milk as affected by the Level of Protein feeding. Part 1. Chemical Composition by A. E. Perkins; Part 2. **Nutritive Properties** by W. E. Krauss and C. C. Hayden. (*Bulletin No. 515 of the Ohio Agrl. Expt. Station, U. S. A. 1932*) (1). Experiments on Holstein cows, carried on since 1920, on the effect of different nutritive ratios ranging from 1:2 to 1:13 on the chemical composition of the milk, shows that the protein level of the ration supplied to cows has practically no effect on the character of the milk—the fat, lactose, solids and protein nitrogen being of the same order as in the controls. The only variation which is consistent and progressive from group to group is the percentage of residual or non-protein nitrogen in milk, which increased in amount as the level of protein feeding increased. The portion of the non-protein nitrogen which shows the greatest amount of variation in response to increased protein feeding, is the urea nitrogen which is increased eightfold from the lowest to the highest group. Amino nitrogen and creatine—creatinine nitrogen are also apparently affected to a lesser extent. The increase in non-protein nitrogen appears to be coupled with a slight increase in the protein of albumin on the highest protein feeding. The character of the fat as indicated by the saponification value, the Reichert-Meissl value, the iodine value and hardness has apparently been unaffected by the level of protein feeding. The great extremes in protein feeding employed in these experiments have produced only relatively

minor variations in the composition of the resulting milk. Hence the authors arrive at the conclusion that no changes of major significance in the composition of milk need be expected from the relatively small variations in the level of protein feeding of dairy cows which are likely to be encountered in practice. (2) Nutrition experiments with albino rats and heifer calves in order to test the nutritive value of milk produced by cows fed extremely high—protein, extremely low protein and normal protein rations, showed that vitamins A and D were uneffected but vitamin B (complex) showed a response, indicating a relationship between the level of protein feeding and the amount of vitamin B complex) secreted in the milk 15 cc of "normal milk" 16 cc of "protein milk" and 20 cc of "low protein milk" were required to allow normal growth on a basal diet deficient in the B complex. No difference was found in the total nutritive effect, based on the method of exclusive milk feeding, or in the biological value of the milk proteins, based, on gain per gram of protein intake. The authors conclude that cows may be fed rations varying markedly with respect to protein quantity without materially influencing the biological value of the milk produced on these rations (C. N.)

Studies on the Nutritive value of Milk. II. The effect of Pasteurization on some of the nutritive properties of milk. By W. E. Krauss, J. H. Erb and R. G. Washburn. (*Bulletin No. 518 of the Ohio Agri. Expt. Station U. S. A. 1933*). Nutrition studies with albino rats to test the effect of pasteurization, if any, on the biological value of milk, showed that rats fed exclusively on cow's milk. whether raw or pasteurised, soon developed nutritional anaemia and died. Haemoglobin determinations and red cell counts showed that nutritional anaemia developed on each kind of milk at about the same rate. The anaemia was related to deficiency in copper and iron in both raw and pasteurised milk. Copper and iron determinations showed that no loss of these elements occurred under commercial conditions of pasteurization (heating to 143°—144° F or 62° C for 30 minutes in closed vessels). When the factor of anaemia was eliminated by daily additions of copper and iron to the milk fed, (as an exclusive diet), no significant difference was found in the total growth of rats fed on raw or pasteurised milk over a period of twelve weeks. The calcium and phosphorus in pasteurised milk are as readily available as in raw milk. Using standard methods for determining vitamins A, B, G, and D, it was found that pasteurization does not affect vitamins A, G, and D. but destroys at least 25 % of the vitamin B in the original raw milk. 24 samples of milk were tested for hardness of curd; after pasteurization, 16 were softer and seven were harder than before pasteurization. The work of the present authors and of others show that the main adverse affect of pasteurization is a partial destruction of vitamins B, and C. Bottle—fed infants constitute the group most apt to be affected, in as much as cow's milk comprises their sole or chief food and the authors recommend in such cases the supplementary feeding of foods rich in vitamin B (cereals, green vegetables, egg yolk etc) and vitamin C (egg, juice of oranges, tomatoes, lemon etc.) (C. N.)

Absorption of Vitamin B (B_1) by Plant tissue by Carey, D. Miller and Marjorie G. Abel (*Jour. Biol. Chemistry, 1933 vol. 100, No. 3, pp. 731—735.*) The authors in their nutrition experiments on the pickling of vegetables with rice bran and salt have found that the Chinese Cabbage (*Brassica chinensis*) gained as much as four times the original value in vitamin B_1) in spite of careful precautions to wash off the traces of bran, after pickling, before test. If the same vegetable was pickled with salt only, it was found that it lost 50 % of the original vitamin B_1 content. These results indicate that the cabbage acquires vitamin B_1 from rice bran probably either by diffusion of the water—soluble vitamin into the tissues of the leaves or by the absorption of vitamin B by leaves. Such transference of this vitamin from the pericarp or outer layers of the rice grain into the inner

portion or endosperm when the rice is parboiled, has been shown to occur by Aykroyd (1932, *Jour. of Hyg. vol. 32, p. 184*) These results could be utililed to advantage for increasing the vitamin B content of our diet by using rice bran in the salt-pickling of vegetables and probably also in the cooking of vegetables. (N. P.)

Gleanings.

Artificial control of sex in the Progeny of Mammals. N K Koltzoff and-V. N. Schroder of the Institute of Animal Breeding, Moscow, write in 'Nature' as follows :— Genetics and Cytology prove that the sex of the progeny of Mammals depends upon the sex of the spermatozoon fertilising the ovum ; the ovum itself is not determined as to sex. The 'female' spermatazoon possesses an X-chromosome, the 'male' possesses a Y-chromosome (or no sex chromosome at all), while every ovum has an X-chromosome. Male determining and female determining spermatozoa are mixed irregularly in the sperm. Therefore there is only one way of controlling the sex progeny in Mammals, namely by separating the male-determining from the female-determining spermatozoa.

Spermatozoa with X- and with Y- chromosomes are derived from one asym metric mother (X+Y) cell ; it was accordingly natural to suppose that they would carry electrical charges of opposite sign We accordingly tried to isolate them with an electric current. Most living cells during cataphoresis go to the anode, their surfaces being electrically negative. When we passed an electric current through horse or rabbit sperm in physiological solution, we found that part of the spermatazoa went to the anode, part to the cathode, while the rest remained somewhere in the middle in the horizontal part of Michaelis apparatus.

We have artificially impregnated three female rabbits with three portions of sperm after cataphoresis. The female impregnated with anode spermatozoa produced six young, all of the female sex; the second, impregnated with cathode spermatozoa, produced four males and one female ; and the third, impregnated with the central fraction left between the two poles of the Michaelis apparatus, bore two males and two females. So far, this is the only experiment we have carried out on artificial impregnation with anode- and cathode- spermatozoa, and we propose to verify it on a larger scale. However it is most improbable that the resuels were due only to chance. The only exception to what we expected was a female born after fertilisation with cathode-spermatozoa which can be explained by the difficulty of obtaining complete isolation by mechanical means of three varieties of sperm in a Michaelis apparatus.

(*Nature*, March 4, 1933, p. 329.)

Insects And Microclimates. It is well known that when water is exposed to dry air, evaporation takes place and the liquid becomes cooler than its surroundings ; when a dish of water is placed in still air at 30° C, the temperature of the water is sometimes considerably lower than that of the air. The amount by which the water is cooler depends upon the humidity of the air, for the lowering of the temperature is directly proportional to the rate of evaporation, which is governed by the saturation deficiency. In our experiments, when the air in the room has a humidity of 73%, then the temperature of the water is 27·9° C, and when the humidity is 40 % ; then the temperature is 22° C. The air immediately above the water in the dish has approximately the same temperature as the water. Experiments have shown that *Culex fatigans* is killed by an exposure to 41° C for an hour, and it is suggested that its habit of resting in damp situations has enabled this insect to survive in countries where the shade temperature is frequently considerably above 41° C.. Many insects which are

found in these situations are probably attracted there by the lower temperature and not by the high humidity. The large fall in temperature due to evaporation means that the conditions to which many insects are subjected are even more different from those measured by standard metereological methods than is usually realised. In experiments with a number of different insects, we have, shown that exposure to dry air is usually more rapidly fatal than exposure to moist air at the same temperature. At first sight, this would imply that, for any given temperature, the higher the humidity the more favourable the conditions for these insects; but it is possible that the effect may be the reverse, for the high atmospheric humidity will prevent evaporation and raise the temperature to which the insect is actually subjected. For example, in air at 35° C with a relative humidity of 90 %, the temperature of the water would be 33° C (assuming that 2·5 mm. saturation deficit gave a reduction of 1° C which was the amount found in our experiments). If, however, the air was at 40° C and had a relative humidity of 10% conditions would prove more rapidly fatal to many insects than if the water were only be at 20° C. We should like to direct the attention of Entomologists to these observations, in the hope that they will study the climatic conditions of the air in wells, over collections of water, in rot holes and in other places where insects are found resting. (H. S. Leeson and Kemeth Mellanby *in 'Nature', March 11, 1933, p. 363.)*

Inherited Resistance to Infectious Diseases. Studies with mice at the Rockefeller Institute, New York, show that resistance to disease is a heriditary trait like color of eyes, hair or skin. Strains of mice highly susceptible to or highly resistant to a given disease may be segregated by selective breeding, Dr. Leslie T. Welster reported at the Washington meeting of the American Association of Pathologists aud Bacteriologists. Starting with a strain of mice 37 % susceptible to mouse-typhoid, he selected lines 85 % and 15 % susceptible, respectively. The 85 % susceptible lines were descendants of mice highly susceptible to mouse-typhoid while the 15 % susceptible decended from relatively resistant mice. Resistance factors are dominant and not sex-linked, Dr. Webster found. Mice from strains resistant to disease were heavier but not more fertile than the susceptible mice. The tissues throughout the bodies of these resistant mice seemed less sensitive to the organism causing mice-typhoid than did the body tissues of susceptible mice. This suggested to Dr. Webster that the heriditary factors giving resistance to disease exercise general rather than local influence in the animal body. These heriditary factors concerned with resistance or susceptibility to disease can operate against a number of but not necessarily all harmful agents. So that an animal, possibly a man or woman, may be born with ability to resist attacks of a number of diseases, but still may be susceptible to a few infectious diseases (*Science News, May 12, 1933*).

World Production And Use Of Soap. The estimated world production of soap in 1932 was 4·7 million tons, according to figures published in Die Chemische Industrie (Mar. 18, 1933, p. 197). Of this, 2·5 million tons were made in Europe, 1·8 million tons in America, and 300,000 tons in Asia and Africa. Almost all countries have increased their production over the pre-war level. In Russia production has been tripled, though it still represents only 2·5 kg., per head of the population. The greatest use of soap per person is in the U. S. A. (11 5 kg), whilst England has a consumption of 9 kg per head per annum. (*Chemistrandy Industry, April 21, 1933*).

Industry in Madras. The report of the Department of Industries in Madras for 1932 emphasises the great need for changes in the Agricultural policy of the Madras Presidency. It is pointed out that there is no reason why much of the land now devoted to growing rice should not be utilised for crops such as

sugar cane, some 80,000 tons of sugar having been imported during the year. The figures with regard to silk production are of considerable interest. 60 years ago silk production in India was very much on a par with that of Japan, but today Japan produces 65 % of the world's silk and India less than 1 %. The amount of mining in the Presidency showed considerable reduction during the year. Only 5433 tons of manganese were mined, as compared wigh 35,000 in 1929, whilst the output of mica, magnesite, barytes and asbestos was also much lower. The tanning industry, which is of considerable importance in S. India, also showed less activity. The evidence of the report regarding sugar manufacture is that there is considerable scope for improved methods of extraction with the employment of centrifugals and centralisation of supplies in small factories. (*Chemistry and Industry, May 19, 1933*).

World Productoin Of Artificial Silk. According to figures published in *Die Chemische Industrie* (Mar 11,1933), the world production of artificial silk in 1932 was 232,8000 metric tons, compared with 149,000 tons in 1927 and 35,000 tons in 1932. The 1932 output represents 80% of the capacity of the existing plants, the chief producers were: United States (59,300 t), England (32,900 t), Italy (32,100 t), Japan (29,200 t), Germany (28,000 t) and France (21,000 t). Production in England and Japan showed a very considerable increase compared with 1931, but in Germany and the United States there was a decline. Over 80 % of the 1932 output was by the viscose process (*Chemistry and Industry, May 19,1933*).

Mysore Soap Factory. The report of the Department of Commerce and Industries, Mysore, for the year 1931—32 shows that during the period under review the total output of soaps in the Government Soap Factory was 240 tons as against 260 tons during the previous year. The sales amounted to Rs. 4,94,539 against Rs. 4,61,940 during 1930—31. In addition to soaps, the factory produced several high grade toilet preparations, such as vanishing cream, boot polish etc. It has since been decided to take up the manufacture of tooth—paste also, in the factory. The preparation of certain medicinal drugs and hospital necessaries from materials available locally was under-taken in the industries—laboratory attached to the soap factory and these articles are being supplied to the medical department. During the year, the factory was enlarged by the construction of additional buildings and installation of new machinery. The Turkey Red oil plant which was sanctioned last year was erected and 10,045 pounds of oil were produced and marketed. (*Mysore Economic Journal, June 1933*).

Remedy For Ranikhet Disease Of Poultry. Steps should be taken to have sick fowls destroyed and burned as soon as the first symptoms of the disease are noticed The whole range of ground used for the birds should be thoroughly disinfected by spreading quick lime over it. Birds should drink nothing but medicated water containing rectified tincture of Iodine at the rate of one tea spoon to a gallon of water till such time as there is the least possible fear of the disease being about the place or near about. Water dishes should be thoroughly washed, cleaned and disinfected every morning. Crows which are the chief source of infection should be prevented from eating and drinking from the birds' food and water dishes. Do not throw away on streets or heaps of rubbish the infected dead brids. An indigenous remedy "*Cure-All-Pills*" prepared by Mr. Mushtaq, Ideal Asil House, Post Office Chuchakwas, District Rontank, has been said to be effective against the disease. (*Indian Poultry Gazette, vol. 21, No. 4, April*, 1933).

Review.

Vernalizaton or Lyssenko's Method for the Pre-treatment of seed. R. O. Whyte and P. S. Hudson (*Bulletin No. 9 of the Imperial Bureau of Plant Genetics, Cambridge, England, 2 sh. 6 d; March 1933*). The Imperial Bureau of Plant Genetics deserve the thanks of the English knowing public for the promptness with which they have brought to their notice some very interesting experiments now being carried on by Russian workers on the pre-treatment of seed material with a view to shortening the ripening period of crops. There were days not, long ago, when important work in foreign countries like the pedological research of Gedroiz, Glinka and others in Russia and the manurial experiments of Mitscherlich, Neubauer and others in Germany, went unheeded for years in the English scientific press, but with the recent improved organisation of Soil, Plant and Animal Bureaus in England, we are apparently in for more uptodate news of the scientific work in other countries.

The new method evolved by the Odessa workers, sometimes called after Lyssenko, its chief exponent, is known in Russian as "Jarovizatzia", in German as "Jarowisation" and has been transliterated into English as "vernalization", and aims, as noted above, at the pretreatment of seed in such a way as to markedly shorten the period of ripening later on when the seed is sown. Such an artificial hastening of the ripening stage even by a few weeks, may find several economic applications, eg. in the introduction of better yielding strains into areas where they cannot be introduced at present on account of their longer period of growth, or say, in obtaining full yields from crops which at present owing to sudden change of season at the ripening stage, end in failure.

The principle of the method is based on the fact that plants require a definite quantity of light and darkness, besides other factors like temperature, humidity etc. for the completion of their maturation period, and this quantity (especially in regard to "darkness") can be given to the plant even in advance and remain stored by it. It is well known from the work of Garner, Allard and others that photoperiodism exerts a powerful influence in controlling the vegetative as well as reproductive functions of the plant; but as the control of photoperiodism on a field scale is not a feasible proposition, the practical utility of these observations was very limited. When however, Rasumov showed the "residiual" or "after-effect" of previous applications of light and darkness, the subject was raised from the plane of theoretical interest to one of economic importance, and Lyssenko has exploited this aspect of "after-effect" in a very interesting way to develop a method of practical utility.

In the words of the authors of the present pamphlet, "Lyssenko's fundamental thesis is that the processes of '*growth*' as exemplified by gain in dry matter content, and the processes of "*development*" or the transition from one stage to another of the reproductive cycle, are two distinct phenomena, not necessarily antagonistic to one another. Consequently, it is possible to influence one of the processes without of necessity interfering with the other. The plant may be subjected for a certain period to the influences which favour its reproductive development, during which time its growth is temporarily held in check, and may later be transferred to other conditions favouring growth; in this way the two sets of processes are duly accelerated. The marked advantage of this method over previous methods based on photoperiodism alone, is illustrated by the fact that in the Odessa experiments an accelerated reproductive development was accompanied by a vegetative development actually in excess of that of the control plants grown from ordinary untreated seed".

An important point to note is that while the physical factors influencing vegetative activity cannot be stored to a great extent in advance by the plant in its very young stages (thereby to ensure active vegetative growth later on even should environmental conditions prove unfavourable), in the case of the factors influencing the period of reproduction (light or darkness, temperature, humidity, etc), these can presumably be stored in any earlier stage of a plant's life, and when so stored, the plant can progressively pass on to the flowering and ripening stages without waiting for favourable seasonal conditions. This capacity for storage of the maturity factors appears to extend to even the earliest stages of the plant's life, so that the Russian workers have elaborated a convenient method of subjecting sprouting seeds to their process of 'vernalization' (or supply of the required maturity factors) in the laboratory prior to sowing in the field. They explain the rationale of the 'vernalisation' process by supposing that in the sexual or reproductive phase of the plant's life, a sequence of biological changes have to take place, for certain stages of which a definite quantity of light or darkness, heat or cold is necessary. The absence of favourable seasonal conditions and a consequent withholdal of the above requirements at the ripening period, naturally delays the further progress of maturation; but when these necessary factors are artificially supplied in advance even at the "sprouting-seed" stage, the important biological links (or changes) are already formed in the seed and hence ripening proceeds at a steady and quick pace.

Now, the amount of darkness, humidity and cold which a plant requires for going through the successive stages to completion of its reproductive phase, varies with the kind of plant. To take some specific problems solved by Lyssenko's method, we will first consider the case of spring-wheat, which it is found difficult to cultivate in the semiarid zones of the Ukranian steppes, on account of the high summer temperature, which damages the plants just at the time they are coming to ear. It would, obviously, be a great advantage if the date of ear formation could be advanced by a period (15 to 20 days in this case, sufficient to escape the high summer temperature. This hastening of maturity has been achieved by subjecting the seeds, prior to sowing, to the process of "vernalization", by allowing them partially to germinate, then arresting germination and keeping the seeds in darkness at a temperature of 3° to 5° C and moisture content of 50%, for a period of 12 to 15 days. Such "vernalized" seed, eared 17 days in advance of the control and gave normal yields, while the untreated seed gave practically no yield.

Again, winter-wheat when grown in spring fails to ear, (according to Lyssenko) not because of the direct harmful effects of the high temperatures in spring and summer generally, but because that temperature is too high for the plant to pass through the stage of vernalisation. Without passing through that stage the wheat cannot proceed to the next and hence reproduction does not occur in such sowings. When the seed is "vernalized" however, i. e subjected to cold and darkness at the sprouting stage, the stages of vernalisation requiring low temperature, proceed to completion even in the seed itself, and so such treated winter-wheat seeds can be sown in spring and grow to harvest normally, inspite of subsequent high temperatures.

Considering the case of short day plants like maize, millet, sorghum, soya bean and other crops associated with tropical and sub-tropical regions, these require a combination of high temperature and short daily period of light for reproduction; and hence it is found difficult to grow them in the nothern regions of long days and low temperatures, Lyssenko and his co-workers have therefore, tried the effect of "vernalising" these short day plants by supplying them with the requisite quantity of darkness and high temperature all in one,

quantum, at the stage of sprouting-seed, and have found that such "vernalised" seed grew and ripened well even as far north as Leningrad.

So much for the rosy side of the picture and the claims made in favour of the new investigations, but these will not lead one, we believe, to suppose that here at last we have found a panacea for all ecological maladjustments, or that the method offers an effective substitute for the Plant Breeder's work. It has to be remembered that the investigations on which the method has been based have extended only over the last 2 or 3 years and as such, are still of a preliminary character. Only large scale field trials with a much larger variety of crops, can reveal the economic possibilities of the method. Lyssenko himself points out that his method does not aim at encroaching on the domain of the plant breeder; rather, it offers a new tool in his hands and throws open a wider field for the Breeder to select his strains from.

The method of 'vernalisation' seems to have little value in cases where the vegetative parts form the economic commodity eg. sugarcane, flax, fodder plants etc, or in cases where the crop is transplanted from a seed-bed or nursery, eg. rice and other cereals, tobacco etc, as it is found that the advantages of vernalization do not persist after such transplantation. Again, it is doubtful whether plants which show no response to photoperiodism would respond to 'vernalisation'. But in spite of obvious shortcomings, the method deserves a careful trial with a view to test its possibilities in this country, which in its continental area and extremes of climatic variations offers many points of similarity to conditions in Russia.

(C. N.)

Crop and Trade Reports.

Final All India memorandum on the Winter Oilseeds (Rape, Mustard and Linseed crops of 1932-'33.

Rape and Mustard. The total area under rape and mustard amounts to 6,052,000 acres, which is 3 per cent below that of last year. The total estimated yield is 1,047 000 tons, as against 1,025,000 tons last year, or an increase of 2 per cent. The detailed figures for the Provinces and States are.—

	Area (1000 acres)		Yield (1000 tons)		Yield per acre (lbs.)	
Provinces and States.	1932—33	1931—32	1932—33	1931—32	1932—33	1931—32
United Provinces.	2,808	2,932	495	467	395	397
Punjab.	1,138	1,150	148	184	291	358
Bengal.	716	770	154	139	482	404
Bihar and Orissa.	627	639	140	136	500	477
Assam	264	302	42	46	356	341
Bombay.	225	165	34	18	338	244
North West Frontier Provinces.	126	107	11	10	196	209
Central Provinces and Berar.	73	70	15	16	460	512
Delhi.	8	8	...	...	107	140
Alwar (Rajputana).	37	40	6	7	363	392
Baroda.	20	21	2	2	224	213
Hyderabad.	10	10	(b)	(c)	66	93
Total.	6,052	6,214	1,047	1,025	388	369

In addition to the areas for which particulars are given above rape and mustard are grown in certain other tracts in India, and the average area so grown for the last five years has been some 275,000 acres with an estimated yield of 48,000 tons.

Linseed. The total area under linseed is returned at 3,239,000 acres which is 2 per cent below the area of last year. The total estimated yield is 403,000 tons which shows a decrease of 3 per cent. as compared with the yield of last year. The detailed figures for the Provinces and States are:

Provinces and States.	Area (1000 acr s) 1932—33	1931—32	Yield (1000 tons) 1932—33	1931—32	Yield per acse (lbs). 1932—33	1931—32
Central Provinces and Berar.	1,105	1,031	90	95	182	206
United Provinces.	850	910	147	158	587	389
Bihar and Orissa.	641	654	97	92	339	315
Bengal.	125	126	25	20	448	356
Bombay.	125	147	14	15	251	229
Punjab.	31	32	3	3	217	210
Hyderabad.	269	306	18	23	150	168
Kotah (Rajputana).	93	95	9	10	217	236
Total.	3,239	3,301	403	416	279	282

In addition to the areas for which particulars ars given above, linseed is grown in certain other tracts in India, and the average area so grown for the last five years amounts to 276,000 acres with an estimated yield of 34,000 tons.

Exports. The statement below shows the principal destinations of exports during the last five years:—(*In thousand tons*).

	1928—29	1929—30	1930—31	1931—32	1932—33
Repeseed					
United Kingdom.	29	8	11	14	11
France.	11	10	11	6	8
Belgium.	2	3	2	1	3
Germany.	9	6	2	4	9
Netherlands.	12	15	4	9	11
Italy.	13	1	2	18	68
Other countries.	1	1	1	2	5
Total.	77	44	33	54	115
Linseed.					
United Kingdom.	18	80	58	14	14
Australia.	22	23	11	10	9
France.	47	51	25	44	21
Germany.	6	10	11	10	9
Netherlands.		7	23		
Spain.	7	7	9	4	2
Italy.	28	28	33	15	11
Belgium.	2	13	13	1	
Other countries.	27	29	74	22	6
Total.	157	248	257	120	72

(From *The Indian Trade Journal*, 6th June 1933).

Irrigation in India. The report of the review of Irrigation in India during the year 1930—31, which has been issued by the Government of India gives some details of irrigation operations in India during the year under review. The total area irrigated by Government Works of all classes in British India amounted to 31 million acres, which was slightly below the previous record area of 31·6 million acres. The largest irrigated area was in the Punjab in which province 11·49 million acres were irrigated. The Madras Presidency came next with an area of 7·6 million acres followed by the United Provinces with an area of 4 million acres and Sind with 3·7 million acres. The total capital outlay, direct and

indirect on irrigation and navigation works, including works under construction, during the year came to Rs. 13,644 lakhs. The gross revenue for the year was 1,209 lakhs of rupees and the working expenses, 569 lakhs, the net return on capital being 4·7 per cent. The capital invested included items of considerable expenditure and of first magnitude like the Metur Project, the Lloyd Barrage, the Sarda Canals and the Sutlej Valley projects. The return was highest in the Punjab, which yielded 12·64 per cent. while in Madras it was 6·17. (*Hindu, July 1, 1933.*)

Agricultural Statistics for 1931-'32. The Agricultural Statistics for 1931—'32 (Provisional) for British India issued by the Department of Commercial Intelligence and Statistics show that the total area of British Provinces, (excluding Indian States) to which the tables appended to the report relate is 669 million acres according to professional survey or 667 million acres according to village papers. Of the latter area, 234 million acres represent uncultivable area comprising forests (89 million acres) and other area not available for cultivation (145 million acres) 155 million acres represent cultivable waste other than fallow, and 49 million acres, the area left fallow during the year. The remainder, 229 million acres, was the net area actually sown with crops during the year. If areas sown more than once during the year be taken as separate areas for each crop, the total area sown in the year 1931—32 comes to 263 million acres, which is slightly greater than that in the preceding year. The total area irrigated amounted to 49 million acres as against 50 million acres last year. Canals irrigated 25 million acres, wells 12 million acres, tanks six million acres. Including the areas sown more than once, the gross area of irrigated crops comes to 52 million acres, of which rice occupied 18 million, wheat ten million, barley, jowar, bajra, and maize together six millions, other cereals and pulses six millions, sugar cane and other food crops two million acres each. Cotton occupied three millions and other non-food crops five million acres. Food crops occupied 216 million acres of the total area sown (including areas sown more than once) and non-food crops 47 million acres. Rice represented 31 per cent. of the total area sown, millets, 15 per cent. wheat ten per cent, oil seeds and gram six per cent. each, cotton five per cent., barley and maize two per cent. each and jute about one per cent. The noticeable decreases were under Jute (—16 million acres chiefly in Bengal), Jowar (—1 million acres mainly in Bombay and the Central Provinces and Berar) and Groundnut (—1 million acres chiefly in Madras and Burma). The only notable increase was in the area under gram (plus two million acres mainly in the Punjab and the United Provinces. (*Hindu, 2nd July 1933.*)

College News & Notes.

New Admissions. Out of the 48 candidates selected and 24 placed on the waiting list, about 42 joined the College and it looks as though the full compliment of 48 may not be available for the First B. Sc Ag. Class. For the new short course instituted this year, 12 students were selected and this class assembled on the 17th July.

Games. Since the commencement of the year all the games are being well patronised and the play grounds and tennis courts are full of life. The hockey field which was hitherto in the main maidan has been shifted to the maidan to the west of the long block of the hostel. This is a welcome change as the new ground being free from tufts of grass is better suited for hockey The cricket season started with two sides—games followed by a match against the local Municipal School in which our boys won by a comfortable margin. We had two matches in

Football, the first against the Coimbatore Athletic Club and the second against the London Mission High School. Though we lost both, our team is showing signs of improvement every day.

Some Old Boys. It is learnt that one of our old boys Mr. T. G. Menon is undergoing post guaduate course in Agriculture at the Imperial Institute of Agriculture at Pusa. It is understood that Messrs. C. J. Dasa Rao and C. Narasinga Rao have been selected by the Andhra University and Mr. Y. V. Narayana by the Indian Institute of Science, Bangalore, for courses in Sugar Technology.

Board of Studies in Agriculture. The University Board of Studies in Agriculture met at the Agricultural College on the 8th July. The members who attended from the moffusil, were Rao Bahadur, M. R. Ramaswami Sivan, Rao Bahadur G. Nagaratnam Ayyar, Principal, College of Engineering, Guindy, and Mr. V. Krishnamurthi Ayyar, Principal of the Madras Veterinary College. It is understood that the Board considered the applications from several graduates for the University Research Scholarship.

University Extension Board. A meeting of the Univesity Extension Board was convened by M. R. Ry. Rao Bahadur C. Tadulingam Avl., Principal of the College at the Agricultural College on the 7th July. Among the members present were the Hon'ble Mr. V. C. Vellingiri Gounder, Mr. C. K. Subrahmania Mudaliar, Rao Bahadur T. A. Ramalingam Chettiar, Mrs. Cherian Jacob and some of the staff of the Victoria College, Palghat, Government College, Coimbatore, and the Agricultural College. The Board discussed the possibilities of arranging for special lectures to be delivered by eminent scholars at suitable centres.

M. Sc. Degree in Research. Information has been received that Mr. Mantha Suryanarayana, B. Sc, Assistant Chemist, Pempheres research has been awarded the M. Sc. Degree by the Madras University for his thesis on "Bio-chemical studies on the development of the cotton boll, with special reference to lint."

Visitors. Among the distinguished visitors to the College were Dewan Bahadur C. R. Tiruvengatachariar, ex-judge of the Madras High Court, who spent about a week on the colony making a study of the different aspects of agriculture, and acquainting himself with the work going on in the several sections.

Fieldmen's Association. The association entertained the Director of Agriculture at a 'tea' on 24th June; a deputation also waited on him, to place before him the grievances of the members of the Association, and the Director gave a sympathetic hearing to the representations.

Weather Review (JUNE— 1933)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	7·6	+1·8	11·0
	Berhampore *	9 2	+3·6	14·7
	Calingapatam	6·9	+2 2	7·7
	Vizagapatam	1 9	−2·0	3·9
	Anakapalli *	4·4	- 1·0	1[illegible]·3
	Samalkota *	5·0	+0·3	7·5
	Cocanada	3 1	−1·7	4·1
	Maruteru *	4·5	−0·3	7 6
	Masulipatam	5·9	+1·4	6·8
	Guntur *	4·7	+1 3	7·0
Ceded Dists.	Kurnool	1·3	−1·6	6·8
	Nandyal *	1·7	−2·9	5·7
	Hagari *	0·3	−0·2	3·4
	Bellary	1·1	−0·7	8·3
	Cuddapah	0·9	−2·0	3·7
	Anantapur	0·2	−1·9	6·0
Carnatic	Nellore	0·7	−0·5	1·9
	Madras	0·7	−0·1	3 8
	Cuddalore	0·9	−0·7	14·1
	Palakuppam *	0 8	−1·9	12·1
	Palur *	0·3	−1·1	18·0
Central	Vellore	0·2	−2·1	3·1
	Salem	6·1	+3·1	10·4
	Coimbatore	0·5	−1·1	6·9
	Coimbatore Res. Inst. *	0·9	- 9·0	9·1
	Trichinopoly	0·1	−1 3	6·9

Division	Station	Actual for month	Departure from normal	Total since January 1st
South	Negapatam	0·1	−1·2	8·9
	Aduthurai *	0·3	−1·1	8·4
	Madura	0·1	−0·5	8·5
	Pamban	...	−0·1	4·0
	Koilpatti *	...	−0·5	5·5
	Palamkottah	...	−0·6	11·8
West Coast	Trivandrum	23·3	+9·9	71·0
	Cochin	29·0	+0·5	81·9
	Pattambi *	34·4	+11·0	64·7
	Calicut	4[illegible]·4	+8·3	87·8
	Taliparamba *	45·7	+6 7	68·1
	Kasargode *	45·2	+8·8	71·1
	Nileshwar *	45·3	+3·9	71·8
	Mangalore	30·7	−6·1	52·2
Mysore and Coorg	Chitaldrug	1·5	−1·3	8 5
	Bangalore	1·8	−1·1	10·8
	Mysore	0·6	−2·3	13·1
	Mercara	34·9	+8·5	54·9
Hills.	Kodaikanal	1·4	−2·6	25·1
	Coonoor *	0·8	−2·4	18·7
	Kallar *	1·6	−0·3	21·5
	Ootacamund *	2·7	—1·9	20·4
	Nanjanad *	4·0	—4·3	19 8

* Stations of the Agric. Dept.

Summary of general weather conditions: The monsoon which was active on the West Coast and which had penetrated into the central parts of the country at the beginning of the month, weakened about the 6th and continued so till about the 12th. A shallow depression appeared off the Circars—Orissa coast on the 12th and induced a fresh indraught of the monsoon winds by setting up a steep gradient over the peninsula. The depression intensified on the 14th and lay centred about 18° N and 86°E, developed into a storm on the next day, and crossing the Orissa coast lay near Chandbali on the morning of the 16th. It weakened into a depression and merged into the seasonal low pressure area extending from Baluchistan to the Ganjam coast by the 18th. This depression gave rise to widespread rainfall in the belt of country extending from the Konkan to the Orissa-Ganjam coast. The monsoon continued to be active on the West Coast till the end of the month though it was weak over the peninsula from the 20th. Except for a few showers rainfall was scanty over the south of the area and absent from the extreme south.

The chief falls reported were: Kasaragod 9·3″; Niriamangalam (Travancore) 7 3″; Peermad 7·1″ (21st); Wadakancheri (Cochin) 5·2″ and Quilon 5·1″ (21st); Mangalore 5·1″ (5th); Cochin 4·9″ (2nd); Berhampore 4·9″; Calicut 4·9″ (30th).

Rainfall was in excess in the West Coast districts, Coorg and Ganjam, in parts of Kistna and Guntur, and locally in Salem, and in large to moderate defect elsewhere. Temperature was generally below normal over the south and central parts of the peninsula in the first half of the month and in excess over the Coromandel coast in the latter part. The highest temperature recorded was 105° at Nellore, where the maximum for the greater part of the month was above 100°F.

Weather Report for the Research Institute Observatory: Report No. 6/33.

Absolute maximum in shade	91·5°
Absolute minimum in shade	66·5°
Mean maximum in shade	87·6°
Departure from normal	– 1·6°
Mean minimum in shade	72·7°
Departure from normal	– 0·2°
Total rainfall in month	0·91 inches.
Departure from normal	– 0·86 „
Heaviest fall in 24 hours	0·44 „
No. of rainy days	3
Mean daily wind velocity	7·1 M. P. H.
Departure from normal	– 1·4 M. P. H.
Mean humidity at 8 hours	67·5 %
Departure from normal	– 2·8
Total hours of bright sunshine	199·7
Mean daily hours of bright sunshine	6·7 hours.

General weather conditions: The weather was generally fine with the total rainfall below normal. The monsoon was generally weak except between the 15th and 19th when some rain fell. Temperature was below normal during the day and nearly normal at night. The day temperature was above normal during the second and last weeks of the month with a weak monsoon and bright weather.

P. V. R. & T. S. L.

Departmental Notifications.

I Circle. D. Hanumantha Rao, A. D., Razole, l. a. p. from 19—6—33 for one month. **II Circle.** J. Suryanarayana, A. D., Vinukonda, l. a. p. for 12 days from 3—7—1933. T. Paramanandham, F. M., Guntur l. a. p. for nine days from 22—6—33. **II Circle.** P. S. Manian, A. D., Siruguppa, l. a. p. for nine days from 8—6—1933. S. Muthuswami, A. D., Siruguppa, l. a. p. for one and a half months from 3—7—1933. K. Balaji Rao, A. F. M., Hagari, l. a. p. on M. C. for two months from 19—6—1933. **IV Circle.** B. Siva Rao, A. D., Madanapalle, l. a. p. for one month from 14—6—1933. M. Gopala Unnithan, A. D., Saidapet, l. a. p. on M. C. for two months, extension from 17—7—1933. **V Circle.** S. Venkataraman, A. F. M., Aduturai, l. a. p. for 13 days from 26—6—1933. **VI Circle.** V. Chidambaram Pillai, A. D., Srivaikuntam, l. a. p. for one month from 21—6—1933. A. K. Ganesa Iyer, A. D., Nilakkottai, l. a. p. for one month from 2—7—1933. T. S. Venkataraman, A. D., Palni, extension of l. a. p. for four months from 7—7—1933. **VII Circle.** P. A. Venkateswaran, A. D., Palghat, on expiry of his leave, transferred to the Agricultural College as Assistant Lecturer. K. Soopi Haji, A. D., Kasargod, l. a. p. for 15 days from 7—7—1933. **G. E. Section.** A. G. Ramaswamiah, Sub-assistant, l. a. p. for two months from 12—6—1933. **Cotton Section.** S. M. Kalyanaraman, Asst., l. a. p. for six days from 19—6—1933. **Principal's Section.** M. Ratnavelu, A. F. M., Central Farm, l. a. p. for three months from 13—6—1933. **Paddy Specialist's Section.** S. Dharmalingam, Asst. extension of l. a. p. for ten days from 25—5—1933. V. Viswanathan, A. F. M., Central Farm, extension of leave for 16 days from 17—6—1933.

The following 34 probationers in the Madras Agricultural Subordinate Service, V Grade, who have completed their periods of probation satisfactorily are confirmed :— P. Seshadri Sarma. K. Kunhikannan Nambiyar. S Sundaram. A. Ramadas. T. V. Rangaswami. P S. Krishnamurti L. Nilakantan. N. K. Thomas. S. Madhava Rao. P. N. Krishnaswami. C. R. Seshadri. R. Krishnamurti. A. H. Subrahmanya Sarma. M. P. Narasimha Rao. K. H Subrahmanya Iyer. T. N. Balasubrahmanya Iyer. C. Annamalai. M. Somayya. G. Ranganathaswami. T. S Sundaram. P. S. Venkatasubrahmanyam. M. Jivan Rao. M. Kalimuthu. K. Raman Menon. J. Suryanarayana. P. Govindankutti Kurup. S. Ramaswami. K. V. Natesa Ayyar. K. Sanjiva Rao. P. S Narayanaswami. T. Natarajan. D. Hanumantha Rao. T. S. Lakshmanan. M. Rayappa Pillai.

ADDITIONS TO THE LIBRARY, DURING APRIL, 1933.

(Including books for the Students' Library.)

A. Books.

1. *Royal Institute of International Affairs-Pub* (1932) World Agriculture; An International Survey. 2 *Wolfanger, L. A.* (1929) Major World Soil Groups and Some of their Geographic Implications 3. *Robertson, C. J.* (1932) Geographical Aspects of Cane Sugar Production 4. *Hartwell, B. L.* (1932) The Influence of Fertilisers on Crop Quality. 5. *Cheema G. S.* (1932) The Marketing of Fruits and Vegetables in Bombay. 6. *Wood, R. C* (1933) A Note-book of Tropical Agriculture. 7, (1933) Sugar Reference Book and Directory, 1932—33. 8. *Wilson, J. D* (1932) Environmental factors in Relation Plant Diseases and Injury—A Bibliography 9. *Read (Margaret)* (1931) The Indian Peasant Uprooted: A study of the human machine. 10. *Mohan, M. C.* (1932) Guide to Agricultural Industries 2nd Edn. 11. *Vakil C. N. and Others.* (1931) Growth of Trade and Industry in Modern India. 12 *Panandikar, S. G.* (1926) The Wealth and Welfare of Bengal Delta. 13. *Chablani, H L.* (1932) Indian Currency, Banking & Exchange. 14. *Shamasastri, R. (tr.)* (1929) Kautilya's Artha Sastra—3rd Edn. 15 *Boag, G. T* (1933) The Madras Presidency—1881—1931. 16. *Findlay, J. J.* (1923) Principles of Class Teaching.

Madras Government Publications.

17. Tamil Equivalents of English Terms in Natural Science (1933) 18. Malayalam Equivalent of English Terms in Natural Science. (1933) 19 Malayalam Equivalents of English Terms in Physics (1933) 20. Kanarese Equivalents of English Terms in Physics (1933).

B Reports.

1. Report of Work on the Coffee Experiment Station, Palehonnur. *Mysore Coffee Expt. Stn. Bull No. 8.* 2. Canadian Seed Growers' Association : Annual Report for 1930—31. 3. Canadian Seed Growers' Association : Annual Report for 1931—32: 4. New York State Agricultural Experiment Station : Fifty-first Annual Report for the year ending 30th June 1932. 5. Iowa Agricultural Experiment Station. Report of Agricultural Research for the year ending 30th June 1932. 6. Proceedings of the Eighth Annual Convention of the National Fertilizer Association, 1932. 7. Colony and Protectorate of Nigeria : Report on the Agricultural Department for the year 1931. 8 Uganda Protectorate:— Annual Report of the Department of Agriculture for the year ended 31st December 1931. (Part II). 9. Colony of Mauritius. Report on the College of Agriculture for the year 1931

C. Bulletins and Special Publications.

10. The Villagers' Calendar, 1933—34 (Kanarese), *Madras Agri. Dept Pub.* 11 Barley Survey. A Study of Barley Production Exports, Imports Marketing, Markets and Prices in the Principal Exporting and Importing Countries in the World

Empire Marketing Board Bullettin, No. 62. 12. Soils and Fertilizers by E. M. Crowther. (*Reprint*). 13. The Land Utilisation Survey of Britain by E. C. Willats. *Reprint Geography, Vol. 27/3, 1932.* 14. Sugarcane Variety Trials, Bullettin 1932. *Trinidad and Tobago Agri Dept Pub.* 15. Classification of Canadian Spring Wheat varieties. *Cane. Seed. Grow. Asso. Plant Breed. Ser. No. 1.* 16 Utilization of Farm Wastes: Production of starch from Sweet Potatoes (Culls). *Reprint. Ind. Eng. Chem. 23, 1931.* 17. Utilization of Farm Wastes: High Alpha Cellulose from Bagassa. *Reprint Ind. Eng. Chem. 24, 1932.* 18. Utilization of Farm Wastes: Furfural from Corn Cobs. *U. S. A. Bur. of Chem. Pub.* 19. Farm Waste for Paper and Board Making. *Ind. Farm. Products Dvn. U. S A. Pub.* 1929. 20. Information on Industrial Alcohol: Alcohol from Waste Products of the Farm, by W. W. Skinner. 19_2. 21. Utilization of the Potato, by H. C. Core, 1921. 22. Publications issued by the Color and Farm Waste Division. *Bur. of Chem. & Soils, U. S. A.* 1916—1932. 23. World Situation in Oils and Oilseeds. *For. Crops & Mar. August* 1932. 24. World Sugar Situation 1932. *Rept. Do. Do. May* 1932. 25. Studies in Soil Bacteria: A Preliminary Account of the Distribution of Azotobacter in Some Transvaal Soils. *University of Pretoris Reprints.* 26. A Regrouping of Cultivated Barleys with Suggestions on the Classification of Cultivated Plants. *University of Pretoria Reprints.* 27. Pasture Studies: A Preliminary Analysis of the Grazing Conditions on A Potgieterarust Farm. *University of Pretoria—Reprint, No. 1.* 28. The Use of the Chattel Mortgage (Notarial Bond) in Agricultural Finance. *University of Preteria-Reprint, No. 2.* 29. Petrographic Methods for Soil Laboratories. *U. S. Agri. Dept. Tech. Bull. No. 344.* 30. Effect of Lead Aresnate Insecticides on Orange Trees in Florida. *U. S. Agri. Dept. Tech. Bull. No. 350.* 31. Farm Handbook: A Compendium of useful Information--1932. *Iowa A. E. S. Pub.* 32. Selection for Resistance to Fowl Typhoid in the Chicken with Reference to its Inheritance. *Iowa A. E. S. Pub.* 33. Normal Growth in Dairy Cattle. *Iowa A. E. S. Res. Bull. 154.* 34. The Relation-ship of Acetylmethyl-carbinel and Diacetyl to Butter Cultures. *Iowa A E. S. Res Bull 155.* 35. Mastitis: The Use of Certain Dyes in the Treatment of Mastitis. *New York A. E. S. Tech. Bull. 205.* 36. Weed Seeds Found in Vegetable Seeds. *New York A. E. S. Bull 616.* 37. Experiments in Cherry Pollination. *New York A. E. S. Bull. 617.* 38. Hereditary & Environmental Factors affecting Variability in Egg Production. *Massachusetts A. E. S. Bull. 289.* 39. Artificial Ripening of Fruits and Vegetables. *Minnesota A. E. S. Bull. 247.* 40. Corn in its Northern Home. *N. Dakota A. E. S. Bull. 257.* 41. Buttercup Squash: its origin and Use. *N. Dakota A. E. S. Bull. 258.* 42. Fungi of Flaxseed and of Flax-Sick Soil. *N. Dakota A. E. S. Tech. Bull. 259,* 43. Effect of Weathering and Stage of Maturity on the Palatability and Nutritive Value of Prairie Hay. *N. Dakota A. E. S. Tech. Bull.* 260. 44 Roses in the Garden. *N. Jersey A. E. S. Cir.* 251. 45. Farm Tenancy in Delaware. *Delaware A. E. S. Bull.* 178. 46 Freight Rates and the South Dakota Farmer. *S.Dakota A. E. S. Bull* 269. 47. Variations in Amounts of Carbohydrates in the Leaves of Corn. „ „ 270. 48. Rye as a Fattening Food for Cattle and Swine in South Dakota. „ „ 271. 49. A Review of Research on the Control of Wireworms. *Pennsylvania A. E. S. Bull.* 259. 50. Experiments in Tomato Production. *A. E S. Bull.* 227. 51. Managing Confined Fowls. *A. E. S Bull.* 246. 52. The Effect of Selection in the Tomato. *A. E. S. Bull.* 248. 53. Factors Influencing the Vitamin Content of Foods. *A. E. S. Bull.* 275. 54. Series on California Crops and Prices: *Dairy Products. California A. E. S. Bull.* 514. 55. Operations of the Poultry Producers of Southern California, Inc. *Bull.* 516. 56. Nectar and Pollen Plants of California. *Bull.* 517. 57. A Survey of Infectious Laryngotracheitis of Fowls. *Bull.* 520. 58. Series on California Crops and Prices. *Alfalfa.* *Bull.* 521. 59. Diseases of the Date Palm, Phoenix Dactylifera. *Bull.* 522. 60. Maturity Tests for Table Grapes. *Bull.* 529. 61. Walnut Dehydraters, Characteristics, Heat Sources, and Relative Costs. *California A. E S. Bull. 531.* 62. An Analysis of the East Bay Milk Market.

California A. E. S. Bull. 534. 63. Water Requirements of cotton on Sandy Leam Soils in Southern San Jeaquin Valley. *California A. E. S. Bull. 537.* 64. Soil Eresion in California. Its Prevention & Control. *California A E S. Bull.* 538 65. Harvesting & Drying Rough Rice in California. *California A. E. S. Bull.* 541. 66. Soils in Relation to Fruit Growing in New York, Part 1. A Detailed Soil Survey of the Hilton Area, Monroe County. *Cornel A. E. S. Bull. 541.* 67. Killing Perennial Weeds with Chlorates during winter. *Cornell A. E. S. Bull. 542.* 68. Co-operative Purchasing & Marketing Organisations in New York State. *Cornell A. E. S. Bull. 544.* 69. The Marketing of Milk Thru Ice Cream. *Cornell A. E. S. 546.* 70. An Analysis of the Loaning Operations of the Federal Land Bank of Springfield from its Organization in March 1917 to May 31, 1929. *Cornell A. E. S. Bull. 549.* 71. Soils in Relation to Fruit Growing in New York: Part II–Size, Production, & Rooting Habit of Apple Trees on Different Soil Types in the Hilton & Morten Areas, Monroe County. *Cornell A. E. S. Bull. 550.* 72. The Sheep Tick & its Eradication by Dipping. *U. S. Farmers' Bull. No. 798.* 73. A Simple Way to Increase Crop Yields. *U. S. Farmers' Bull. No. 924.* 74. Strawberry Culture South Atlantic & Gulf Coast Regions. *U. S. Farmers' Bull. No. 1026.* 75. Making Woodlands Profitable in the Southern States *U. S. Farmers' Bull. No. 1071.* 76. Utilization of Flue-Heated Tobacco Barns For Sweet Potato Storage. *U. S. A. Farmers' Bull 1267.* 77. High-Grade Alfalfa Hay: Methods of Producing Baling & Loading for Market *U. S. A. Farmers' Bull. 1539.* 78. Insect Enemies of the Cotton Plant. *U. S. A. Farmers' Bull. 1688.* 79. Preparing Apples for Market in Barrels and Baskets. *U. S. A. Farmers' Bull. 1695.*

D. Circulars Etc.

80. Mustard Beetles. *Min. Agri. & Fish. Adv. Leaf. 157.* 81. Storing of Mangolds and Turnips. *Min. Agri. & Fish. Adv. Leaf. 158.* 82. Swift Moths. *Min. Agri. & Fish Adv. Leaf. 160.* 83 The Raspberry Beetle. *Min. Agri. & Fish. Adv. Leaf. 164.* 84. A Complex Method in Climatology and its Application to Agriculture. *New Jersey A. E. S. Cir. 201.* 85. Observations on the Mexican Fruit Fly and Some Related Species in Cuernavaca, Mexico, in 1928 and 1929. *U. S. Agri. Dept. Cir. 255.* 86. Downy Mildew of Tobacco. *U. S. Agri. Dept. Cir. 263.* 87. Fires on Farms. *U. S. Agri. Dept. Leaf 44,* 88. Wind Resistant Construction for Farm Buildings. *U. S. Agri. Dept. Leaf. 87.* 89. Rockeries. *U. S. Agri. Dept. Leaf.* 90. Red-Clover Seed Production in the Intermountain States. *U. S. Agri. Dept. Leaf. 93,* 91. Indebtedness on 48 Potter County Farms, 1930, Preliminary Report. *S Dakota A. E. S. Cir. No. 2.* 92. Preliminary Report Feeding Flax Straw to Cattle. *S Dakota A. E. S. Cir. 3.* 93. Farm Real Estate Mortgage Loans in Hyde County, South Dakota 1910—1930 with Special Reference to Loomis, Valley & Spring Lake Township. *S. Dakota A. E. S. Cir. 4.* 94. Mortgage Loans on Farm Real Estate in Haakon County, S. Bakota. With Special Reference to Elbon Topbar & Milesville Townships. *S. Dakota A. E. S. Cir. 5.* 95. Land Drainage in Pennsylvania. *Pennsylvania A. E. S. Cir. 112.* 96. Loading Baskets of Fruit and Vegetables into Cars *Pennsylvania A. E. S Cir. 116.* 97. Milk Houses. *Pennsylvania A. E. S. Cir. 139,* 98. Beekeeping in Pennsylvania. *Pennsylvania A. E. S. Cir. 141.* 99. Beauty in Furniture Arrangement. *Pennsylvania A. E. S. Cir. 142.*

E. Translations.

100. Quantitative Inheritance by Sirks (M. J.) *Imp. Bur. of Plant Genetics.*